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Rediscovering Our Resources:

***Achieving Higher
Value-Added
in Ontario's Mineral Sector***

May 1994



**Ministry of
Northern Development
and Mines**



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John Stanley



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"This report examines how mineral investment in Ontario can be enhanced through a long term focus on technology and the promotion of more higher value-added activities throughout the sector."

Executive Summary

The goal of Ontario's Industrial Policy Framework is to increase productivity, enhance the province's presence in world markets, and create a higher-skill, higher-wage economy that will raise our living standard.

"Rediscovering Our Resources" works within that framework to examine a number of challenges currently facing the mineral sector and proposes solutions and partnerships that will enable the sector to achieve a higher value-added component. Challenges include a generally poor public perception of the sector, a lack of understanding of the importance of mining to the overall economy, inappropriate or inadequate skills training for an increasingly high-tech industry, declining levels of research and development and declining ore reserves exacerbated by falling levels of mineral exploration.

Other issues facing the mineral sector, such as the rate of taxation, land access and tenure, Aboriginal concerns, and complex and costly environmental assessment procedures, will be examined by the "Whitehorse Mining Initiative", an outcome of last fall's provincial, federal and territorial mines ministers' conference. This initiative brings together mining companies, Aboriginal and environmental groups and labour unions to look at these issues over the next eighteen months.

Mining is a significant contributor to the Ontario economy. The province produces 40% of the national mineral output, and is a world-wide leader in the production of nickel, copper, zinc, gold and gypsum. The value of mineral production in Ontario in 1991 was \$4 billion, and the sector employs over 30,000 workers in the province. Indirect spending and employment due to mining amounts to an additional \$2 billion and 43,000 jobs. A strong industry is also important to a number of northern, mining-dependent communities such as Kirkland Lake, Timmins, Marathon, Red Lake and Manitouwadge.

Mining adds more value per employee to its production than most other major industries in Ontario, and nearly twice as much as the manufacturing sector.

Rediscovering our Resources:

Within this document, mineral supply and demand trends are broadly reviewed, and the outlook for Ontario production and competitiveness is outlined for nickel, copper, zinc, gold, salt and gypsum — all of which are major minerals for Ontario. The strategy also reviews developments in the environmental field in the areas of recycling, pollution abatement, mine closure and mining lands rehabilitation.

Trends in the mining equipment and services industry are looked at with a view to identifying research and export opportunities. Human resource issues, R&D and marketing implications for the industry are also reviewed.

The goal of the mineral sector strategy is to use technology and innovation as a means of achieving a sustainable mineral sector, while creating a broader, more technology-intensive and diverse employment base than exists today.

For more than 100 years, the Ontario government has had a good working relationship with the mining industry, within its mandate to promote and regulate the development and use of the province's mineral resources. Because of the longstanding nature of the relationship, the needs of government and industry are well understood by both sides.

To prepare this strategy, MNDM coordinated numerous public consultation sessions and used research commissioned by various sector agencies. Examples of consultation and research include:

- the SCAN North Task Team—a Ministry-sponsored consultation exercise on value-added in the mining industry
- public consultation sessions focusing on excellence in mining, international marketing of Ontario mining equipment, services and expertise
- a mineral incentives paper and consultation process, to determine how to make provincial incentives more effective
- on-going consultation with the federal and other provincial governments, industry and academe, supplemented by discussions with labour, environmental groups and Aboriginal peoples
- economic research and analyses conducted by MNDM and commissioned by various sector organizations

From this consultation and analysis, several areas have emerged as requiring attention.

1. Public Perception Of Mining

At home, mining has an image problem, perceived by many as a low-tech, low value-added, polluting industry. Its importance as an economic building block is not generally recognized by the public.

Recommendation:

- Foster a better public perception of mining among Ontario residents through increasing the general level of knowledge about mining, particularly its high technology characteristics, its vastly improved environmental performance and its vital economic importance to Ontario's economy.

2. Labour Issues

Training Needs

Industry and labour have identified areas where higher skill levels are required among various occupational groups: from literacy and computer skills among operations workers to environmental awareness among technical and professional staff. Future shortages of professionals are predicted as there is low enrolment in mining-related post-secondary programs.

Recommendations:

- Ensure excellence in professional and technical training, both institutional and company-specific, to meet the changing needs of the present and future workforce.
- Develop improved labour and community adjustment mechanisms.

Employment Equity

Although employees of the mining industry are on average well-paid, the workforce is aging, and dominated by men. Women account for only 10% of the workforce (primarily in clerical positions), and Aboriginal people are concentrated in unskilled and semi-skilled positions.

Recommendation:

- Provide access to better mining-related training opportunities by Aboriginal people and women.

Rediscovering our Resources:

Health And Safety/Technology Linkages

Recommendation:

- Promote higher levels of applied R&D and more technology transfer opportunities in the area of mining health and safety.

3. Technical / Operational Issues

Replenishing of Ore Reserves

If Canada's reserves are not replenished adequately, the mineral sector in Ontario and the rest of Canada could decline dramatically, causing a significant negative impact on the provincial economy, and the many Ontario communities dependent on mining.

Exploration is critical to the continued existence of the Ontario mining industry, through the development of additional reserves in the vicinity of current mining operations, such as in Timmins and Manitouwadge, and through the discovery of new ore bodies.

However, exploration dollars are being spent outside of the country by companies that perceive that all the easily found deposits have already been located, and that Ontario and other Canadian provinces are becoming increasingly high cost mining jurisdictions, due to uncertainties in land access and tenure matters, and in the way environmental regulations are developed.

Recommendation:

- Assist in replenishing Ontario's known mineral reserves, by promoting dialogue on mining sector issues and advancing land-use policies which recognize the importance of mineral development to the Ontario economy.

Low Levels Of Industry Research And Development

The goal of continuous innovation assumes an active and aggressive in-sector research and development component. In general, mining-related R&D is generated by the private sector, and is concentrated in large firms. However, R&D expenditures in the Ontario metal mining sector have declined in recent years, as the level of investment tends to reflect the general health of the economy.

Recommendations:

- Promote increased consultation between industry, labour, government, communities and other sector stakeholders in order to strengthen existing partnerships in the sector and to determine specific value-added R&D priorities for Ontario. More strategic linkages should be made between the mineral sector and those sectors which are present and future end-users of metals, industrial minerals and dimension stone products.
- Encourage technical innovation related to exploration, development, production, closure and mining equipment & services.

Environmental Rehabilitation R&D

In order to comply with mine closure requirements under the new Mining Act in the most cost-efficient manner possible, the mining industry urgently needs substantial improvements in rehabilitation technology.

Recommendation:

- Encourage excellence in applied research and improve business development opportunities in mining lands rehabilitation and other environmental matters by encouraging greater international networking and capacity-building.

4. Marketing

Export opportunities are hampered by a lack of sufficient membership in industry organizations such as the Ontario Mining Equipment and Services for Export (OMESE), with the result that domestic producers are unable to participate in long-range international marketing efforts.

Recommendation:

- Promote aggressive marketing of Ontario's mining-related products and services world-wide.

Some specific initiatives by which these recommendations could be implemented appear in Chapter 5.

1. Introduction

1.1. The Need for an Ontario Mineral Sector Strategy

“Ontario needs an economically and environmentally sustainable mineral sector.”

Ontario is the largest producer of non-fuel minerals in Canada, and the quality and quantity of our mineral reserves places us among the world's major producers of nickel, copper, zinc, gold, and gypsum. However, challenges within Ontario's mineral sector¹ have come to light recently. Mineral reserves, particularly in base metals, are being depleted faster than they are being replenished. Moreover, replenishing these reserves is becoming increasingly difficult, as we are quickly losing ground to other jurisdictions such as Chile in competition for mineral exploration and development capital. This is a major reason why many Ontario mines scheduled to close over the next decade will not be offset by new or expanded operations in the foreseeable future, unless a renewed exploration effort is made.

The purpose of this report is to examine how trends towards declining mineral investment in Ontario can be offset through a more concentrated, long term focus on technology and the promotion of more higher value-adding activities throughout the sector.

As with many sectors of our economy, the overriding concern within the mineral sector is cost competitiveness, as adjusted for comparative investment and risk considerations. Due to the scarcity and increasing mobility of mining capital, broad perceptions regarding cost competitiveness are prime determinants of how successful a jurisdiction will be in attracting mining investment, which is international in character.

The problems associated with Ontario's mineral sector pose complex public policy questions to provincial and federal governments, particularly in terms of how cost competitiveness is affected by such issues as access to land, environmental regulation, the growth of indirect labour costs and comparative tax policies between one jurisdiction and another.

Many policy questions affecting the sector relate to changes in public perceptions and attitudes about mining and the diverse set of values Ontario residents place on public lands and the natural resources they

¹ The Mining Sector is defined and described in Section 1.2.

Box 1

The Whitehorse Mining Initiative

In a brief presented at the 1992 Mines Ministers' Conference at Whitehorse, Yukon Territory by the Mining Association of Canada², the numerous problems facing the Canadian mining industry were outlined.

A consensus among the ministers present was that the challenges brought on by low investment require a concerted and coordinated effort among industry, labour and all levels of government in Canada, to put the industry back on a solid footing. Consequently, it was agreed that a comprehensive plan of action by all jurisdictions was necessary. The process by which this comprehensive plan will be instituted has become known as the "Whitehorse Mining Initiative".

The five major issue areas that will be addressed are: Land Access/Use/Allocation; Environment; Workforce/ Workplace/Community; Aboriginal Issues; Financial Performance/ Taxation.

hold. These issues are being discussed through on-going consultation between industry and government, and through collaborative processes such as the "Whitehorse Mining Initiative" (Box 1).

Beyond these broad policy issues lie other matters equally important to the future of mining in this province, and which are the focus of this report. Over the past century, most of our richest and easily accessible mineral deposits have been discovered and developed. New deposits, while maybe just as rich, will likely be found deeper within the earth or further away from existing roads and other forms of infrastructure. Developing these deposits will cost more, using current technology. On the other hand, countries such as Chile and Brazil still hold bright prospects for discovering and developing rich deposits close to surface and near infrastructure. Capital may therefore be attracted to these countries mainly on the basis of comparative mineral potential, and its perceived impact on profitability.

Ontario could offset its perceived decline in comparative advantage, geological or otherwise, by offering more financial incentives. However, the finances required would be very large, and as deficit reduction policies continue to dominate in today's fiscal climate, provincial governments have less and less flexibility in this area.

Alternatively, it could be argued that relaxing our stringent environmental standards such as those upheld in the Mining Act and the Environmental Protection Act might level the playing field between developed and developing jurisdictions. Ontario residents, however, have made it clear that promoting competitive advantage at the expense of the environment is neither progressive nor desirable.

No doubt, Ontario needs a healthy mineral sector, one that is both economically and environmentally sustainable. Losing the \$4 to \$7 billion that the provincial mineral sector generates would deal a major blow to the economy through the loss of a high technology skill base and approximately 73,000 jobs directly and indirectly dependent upon mining.

1.2. The Mining Sector

Like most other economic sectors, the mining sector is an amalgamation of several discrete industries or sub-sectors. The sub-sectors are best considered in terms of the "mining sequence", or the sequence of steps through which representative mineral deposits go during their natural lifespan. The stages in the mining sequence and associated sub-sectors are:

2 *Competing for Future Prosperity* — a brief presented by the Mining Association of Canada on behalf of the provincial and territorial mining associations and chambers of mines to the 49th Annual Mines Ministers' Conference, Whitehorse, Yukon, September 22, 1992.

1.2.1. Exploration Stage

Exploration is the search for new mineral deposits, which is carried out by the exploration industry. This stage extends from initial discovery in the field through to a stage where a volume or tonnage of rock containing material rich enough to mine has been identified. The exploration industry includes exploration departments or subsidiaries of major mining companies and also includes several hundred “junior mining companies”³ and individual entrepreneurs (i.e. prospectors).

1.2.2. Development Stage

Development is the process of going from identifying a volume of material rich enough to mine through to the detailed calculating exactly how much is there, determining how to extract the deposit from the ground and processing it into material usable by an end-user. This stage involves firms specializing in drilling, shaft sinking, underground excavation and tunnelling, consultants specializing in calculating the volume and value of the resources uncovered in this process, and specialists in financing development and production work.

1.2.3. Production Stage

Production or mining is the actual extraction of ore from the earth. This is the most labour intensive part of the mining sequence, employing the vast bulk of those working in the mining industry. This stage can be broken down into several distinct types of mining with mining methods, machinery and workforce requirements and vastly different earning potential.

- a) **Metal mines** mine ores containing metals such as gold, copper, zinc, or uranium. The unit value of the ore is relatively high, therefore mining methods involve extraction of relatively low volumes of material from underground.
- b) **Non-metallic mines** engage in mining and processing non-metallic minerals such as peat, gypsum, salt, barite, or rocks such as limestone or nepheline syenite. The unit value of these products are uniformly low, therefore mining methods must extract large volumes of material cheaply. Most non-metallic mines are therefore open pit mines similar to large scale quarries.
- c) **Stone quarries** are engaged in extracting blocks of stone for use as building stone or crushed rock for use in road construction or in building products such as portland cement.

³ The definition of a “junior mining company” varies from various authorities and stock exchanges. Generally, a “junior mining company” is an exploration company which has no operating mine anywhere, hence no income.

Box 2

Recent Ontario Government Initiatives Impacting on Mining Include:

- Passing the new Mining Act, after extensive consultation with the mineral sector. Significant improvements were made in the areas of security of land tenure, and the land acquisition process. The new Act also helps ensure that mines are closed out in an environmentally responsible manner.
- Signing the Canada - Ontario Northern Development Agreement (NODA), increasing the amount of resources available for the mineral sector by \$30 million over a 5-year period.
- Announcing the development of a comprehensive geoscience database—the Earth Resources and Land Information System (ERLIS).
- Releasing a mineral incentives discussion paper outlining possible options to stimulate mineral investment in Ontario.
- Requesting Ontario Hydro to undertake a thorough review of its rate structure, to minimize rate increases across the province. This has will have a major impact on the mining industry—a major user of electricity in Ontario.
- Clarifying the terms of Bill 220 and its impact on mineral exploration in Ontario.
- Launching an extensive advertising campaign in southern Ontario, stressing the importance of mining the province.

In metal mining, extraction of ore is followed by milling – a complex process of extracting ore mineral from the surrounding waste rock. Milling is in turn followed by taking the ore minerals, usually a metal combined with sulphur, and proceeding to extract the metal from the ore through the processes of smelting and refining. This stage has spawned a lot of technological developments in Canada to meet environmental requirements.

1.2.4. Mine Closure

The mining operation terminates when continued mining of the ore body is no longer economically viable. At this point Provincial regulations require the mine to be closed in a manner which poses no public safety hazards or environmental concerns. This process is spawning new industries involved in rehabilitation of industrial lands.

1.3. The Importance of Sectoral Consultations and Consensus Building

In recognition of the importance of mining to Ontario, a number of initiatives have been recently undertaken by the Province, in support of the mineral sector. A summary of these initiatives is provided in Box 2.

Continuing dialogue is necessary between mineral sector interest groups and the Ontario Government in all areas affecting mineral sector competitiveness. We must continue to become more innovative in the ways we explore for, develop and market our mineral resources and related products and services. This is critical if the mineral sector is to have a secure and sustainable future in Ontario.

To do this, existing competitive advantage in areas such as geophysical exploration, mineral extraction technology, and environmental technology must be strengthened by building better linkages and partnerships between industry, labour, academia, and government.

This is accomplished through better networking, joint venturing, and through promoting excellence in technical and professional training; by encouraging more research and development throughout the sector, and through the aggressive international marketing of made-in-Ontario exploration and mining technology.

In addition, new strategic R&D partnerships and networks must be forged, particularly with downstream sectors, which are today's and perhaps tomorrow's end-users of mineral products. Discovering new end-uses for our mineral resources may enable us to rediscover our true mineral resource potential.

The Ontario Government has announced its intention to support higher value-added partnerships and networks through the release of a new provincial industrial policy, discussed in the next section.

1.4. Ontario's New Industrial Policy Framework

Through its new "Industrial Policy Framework", released in 1992, the Ontario Government is attempting to assist industry, sector by sector, to achieve higher and broader technological goals.

The policy described in the Framework is "about long-term commitment to economic improvement, not about setting temporary targets for the short term". It sets out a common direction, designed to increase Ontario's productivity, enhance our presence in world markets and create a higher-skill, higher-wage economy that will raise our living standard. The policy is centred upon government-industry-academic partnerships designed to bring sector stakeholders into a process of collective problem recognition and solution.

The Framework also describes the need for regionally sensitive economic development that addresses the serious difficulties of resource industries in northern Ontario.

As stated in the Framework, encouraging innovation, upgrading skills, increasing technological capacity, establishing home-based activities, developing linkages and networks, and building our international capabilities are the key elements, or "competitive fundamentals" that will drive economic renewal and create sustainable prosperity in Ontario.

"Higher value-added" is the conceptual base of the Industrial Policy Framework. This refers to the difference between a company's gross sales or in the case of mining, "total production", less the cost of raw materials and services it buys from other companies (Box 3). The higher the value-added, the larger the income that can be shared by companies and workers.

Mining is already a high technology industry and has a

Box 3

Value Added in Ontario Metal Mining

Value added is the difference between total revenue of a firm and the cost of bought-in materials and supplies. Statistics Canada reports that in 1990 the value added component of Ontario metal mining was \$3.3 billion, on a total production value of \$4.8 billion.

Value Added by Mining Ontario Metal Mines 1990 (millions of \$)

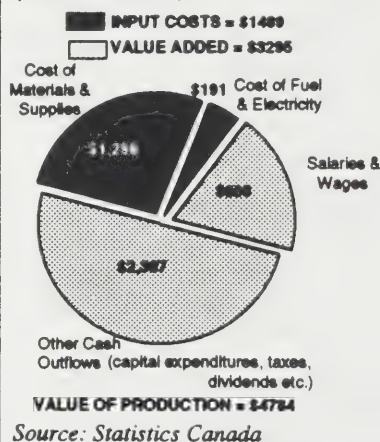
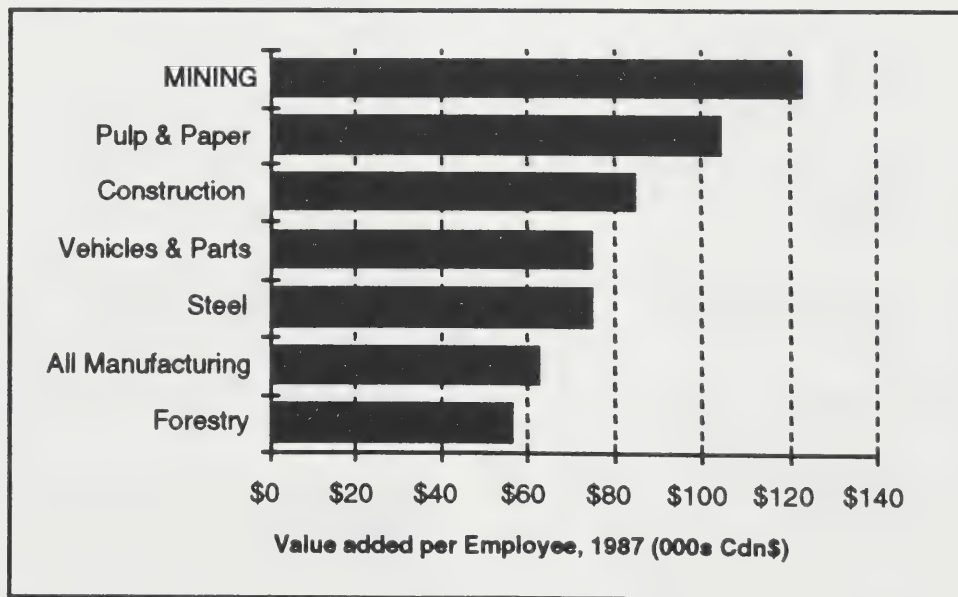


Figure 1. Value added high in the mining industry



Source: Statistics Canada, Ernst & Young calculations

Box 4

The Greening of Sudbury

The natural image of Sudbury has suffered as a result of past mining and forestry activities. However, instead of simply accepting this condition, the Sudbury Region decided to act.

Work began in 1969 through a joint research effort between the Province and Laurentian University. With over \$14 million in funding coming from INCO, Falconbridge and all levels of government, the Region of Sudbury has been able to employ about 3200 people through its Regional Land Reclamation Program.

To date, out of a total of 10,000 hectares of damaged landscape, 40% or 4000 hectares have been rehabilitated. Today these areas bear no resemblance to their former appearance, as grass and trees have replaced the starkness of hard pan soil and rock. More than 1,500,000 trees have been planted since the rehabilitation program began.

In recognition of its contribution to environmental enhancement, the Regional Municipality of Sudbury has received:

- The 1992 United Nations Local Government Honours Award
- The 1992 United States Chevron Conservation Award
- The 1990 Government of Canada Environmental Achievement Award
- The 1990 Lieutenant Governor's Conservation Award
- The 1990 Aboriginicultural Award of Merit
- The 1986 Community Improvement Award

substantial value-added component. The industry is one of the largest contributors of "value-added per employee" in the province (Figure 1).

Raising the mineral sector's value-added contribution to the provincial economy could be accomplished a number of ways, such as:

- Creating wealth by developing more effective exploration techniques
- Increasing production and sales of existing mineral products
- Building capacity and greater export potential with respect to mining-related goods and services
- Achieving greater productivity by developing more efficient and effective exploration and mining processes
- Developing new products and/or end-uses for a broader range of Ontario minerals and mineral products

Higher value-added, particularly that achieved by improved technology, fosters competitive advantage in the mineral sector. It will help Ontario hold its ground against the relatively good mineral potential and low labour and environmental standards of developing countries. It also paves the way for more global business opportunities and export earnings than exist today. For example, Ontario's expertise in geophysical exploration and environmental engineering technology is known the world over.

Ontario's prospects for "green" sunrise industry is illustrated by the Sudbury area's extensive amount of local expertise in mining lands rehabilitation, highlighted by its recent recognition by the United Nations for excellence in this area (Box 4).

Also, Ontario legislation requiring reduced sulphur dioxide emissions from smelters, and legislation governing mine closure are challenging for industry today, but will be a source of higher value-added and competitive advantage tomorrow as public pressure for a cleaner environment intensifies and as Ontario companies become leaders in these fields. International demand for these services is growing, and consequently, so too is Ontario's export potential in these areas.

Focusing on higher value-added through technological achievement can also reduce Ontario producers' vulnerability to volatile commodity markets. The restructuring process under way in the Canadian mining industry emphasizes the need for ongoing productivity improvements, allowing producers to remain competitive during periods

of low prices. Also, by more concerted R&D, mining and mineral speciality products and services can be developed and marketed, promoting product diversification, enhanced profitability and a greater contribution towards higher value-added across the mineral sector.

The Industrial Policy Framework is to be in part implemented through the Sector Partnership Fund (Box 5). SPF assistance is available to facilitate sectoral development, provided that a sector strategy has been prepared that both the sector at large and the Ontario Government agree upon, and provided that the strategy is a fair reflection of the broad range of sectoral interests.

In summary, the higher value-added concept, which is the cornerstone of Ontario's Industrial Policy, is fundamental to the long term prospects of Ontario's mineral sector. Achieving results in this area will enable Ontario to hold its own against new global competitors, and to enter into a new era of enhanced environmental sustainability and new product development. This is already occurring among mining's innovators such as Inco Limited and its achievements in continuous mining systems and diversified nickel products.

1.5. Sector Analysis And Consultation

The following sections summarize the sectoral research and public consultation undertaken to date in support of a value-added mineral sector strategy. It is important to note that, owing to the maturity of the mineral sector, highly effective on-going research and consultation linkages between the Province, Canada, industry and academe are present. These linkages have been used to aid in sector problem definition, consultation and development of focus groups during the preparation of this paper. This network has been supplemented by the inclusion of labour, environmental groups and Aboriginal peoples to reflect the broad level of issues impacting upon the sector.

Information on mineral sector issues has been obtained from a number of sources:

- Public consultation sessions coordinated by MNDM. Results of this consultation are described below.
- Economic research and analyses provided through academic institutions such as the Queen's University Centre for Resource Studies.
- Strategic overviews of the mineral sector, provided by management consulting firms (Coopers & Lybrand, Ernst and Young, Price Waterhouse) and provincial government sources.

Box 5

Sector Partnership Fund (SPF)

The Sector Partnership Fund (SPF) is a \$150 million fund announced by Ontario's Minister of Finance to assist in developing and strengthening sectoral performance. There are four principles to the SPF:

- **Flexibility:** recognizing that each sector is unique and faces different issues
- **Cooperation:** encouraging industry, labour and other interest groups to consult with government to identify common challenges and develop sector strategies.
- **Leverage:** sharing project costs with industry, labour and other levels of government.
- **Accessibility:** providing provincial assistance to all sectors to access funds for good ideas having strong buy-in and a wide impact on the sector.

The fundamental objectives of the SPF are to increase production of higher value-added products, services and processes, and to improve the sector's competitiveness leading to high quality and secure jobs. Within the mineral sector, this can be achieved through networking and conferencing, strengthening mineral sector associations, strengthening international marketing efforts, risk sharing, and promoting consortium-led mineral sector R&D projects.

Box 6

Key references used in this report

- A 1992 report *The Canadian Mineral Industry in a Competitive World*, prepared by the Government/Industry Task Force on Mineral Investment Climate.
- A 1992 report *The Economic and Fiscal Importance of Mining to the Ontario Economy*, prepared for the Ontario Mining Association by Ernst and Young.
- A 1991 report *Ontario Mineral Sector Outlook and Opportunities for the 1990's*, prepared by Coopers and Lybrand for MNDM.
- A 1993 report *Mining Equipment Sourcing Study* prepared for Industry, Science and Technology Canada by Hatch Associates.
- *Human Resources Study of the Canadian Mining Industry*, completed in 1993 by Price Waterhouse for Employment and Immigration Canada, in conjunction with the Mining Association of Canada, the Canadian Institute of Mining, Metallurgy and Petroleum and the United Steelworkers of America.
- A 1992 study *Towards More Efficient R&D in the Ontario Mineral Sector*, prepared by Queen's University.
- Whitehorse Mining Initiative Draft Reports:
 - *Land Access and Security of Tenure Concerns*
 - *An International Environmental Review Country Studies: Chile and Mexico*
 - *An International Environmental Review Country Study: The United States of America*

■ Analysis of mineral sector competitiveness prepared by the Inter-governmental Working Group on the Mineral Industry, for Canada's provincial, territorial and federal Mines Ministers.

■ Human resource surveys of Canadian mining companies, coordinated by industry, government and labour.

Accordingly, a broad and diverse level of information contributed by the mineral sector's key interest groups has been synthesized in this report. Findings and conclusions have been supplemented with public consultation sessions regarding future directions for a higher value-added industry. In this manner, an effective use of the existing mineral sector network obviated the cost and time needed to set up new consultation mechanisms to express the already-identified interests of the sector.

The main consultation elements have been:

■ "SCAN North"

In 1991, The Honourable Shelley Martel, Minister of Northern Development and Mines announced a public consultation project to determine how more value-added activity could be achieved in northern Ontario, to identify potential value-added opportunities in mining, and to develop options allowing the north to capitalize on these opportunities.

This study was done through (1) the appointment of a Task Team consisting of representatives from both industry and labour, (2) public forums in Thunder Bay, Timmins and Sudbury, and (3) through a survey of mining companies to obtain more insight into the subject of value-added. Out of this consultation process came specific ideas which form the basis for some of the proposed initiatives contained in this report. In addition to the SCAN exercise, the Ministry undertook a series of consultative workshops in November 1992 focusing on:

■ "Improving Excellence in Mining"

■ "International Marketing of Ontario Mining Equipment, Services and Expertise and Investment Attraction"

■ "Government - Industry Partnerships in Encouraging Continuous Innovation and Technological Capabilities in Exploration, Mining and Mine Site Rehabilitation"

The Ministry used personnel of the Centre for Resource Studies to facilitate these sessions involving business, labour, government and academia.

Rediscovering our Resources:

The NODA Advisory Committee

Through the Canada-Ontario Northern Development Agreement, \$30 million has been allocated to the mineral sector, of which \$9 million is available through a matching funds program called the "Mining and Minerals Technology Program". This program encourages value-added research and development in three areas: mining technology, environmental technology and processing research. Within each of these areas, an industry-appointed Advisory Committee has been formed to review industry proposals and recommend project approval to Ontario and Canada. Membership on these Advisory Committees represent the interests of many of Canada's leading mining and minerals research organizations.

"The fortunes of mining-dependent communities have closely followed the boom and bust cycles that typify the industry"

2. Economic Importance of the Industry

This section briefly summarizes key facts regarding the provincial mining industry, and highlights the importance of mining to the Ontario economy.

2.1. Historical Background

Many of the first mineral discoveries in Ontario occurred during railway construction across the Precambrian Shield areas of the province. In 1846, copper deposits were discovered near Bruce Mines on the north shore of Lake Huron and silver was reported in the vicinity of Thunder Bay. In 1866, the first gold was found near Madoc and in 1883, the copper-nickel ores of Sudbury were discovered. In 1903, silver and cobalt were discovered at Long Lake, near Cobalt. In 1906, gold was found at Kirkland Lake, and subsequent gold discoveries were made in the Timmins/Porcupine area and in Red Lake. Iron ore shipments from Steep Rock Lake commenced in 1944, and in 1953, the zinc-copper deposits at Manitouwadge were discovered.

Large scale uranium production began in Elliot Lake in 1956 and the zinc-copper-silver discovery in Timmins occurred in 1964, the most significant base metal discovery in Ontario since Sudbury. In the mid 1980s gold was discovered near Marathon and subsequently the three Hemlo gold mines came into production.

The fortunes of prospectors and mine workers and the many mining dependent communities in Ontario have closely followed the boom and bust cycles that typify an industry dependent on world commodity markets. Recently, northern Ontario communities have been hard hit by rising costs, and declining markets. Iron-ore and uranium mining operations have been hardest hit over the past 20 years, causing the shut down of numerous mines, and the substantial downsizing of northern Ontario communities.

Community economic development and business development programming continue to be important government priorities in the north. The Government of Ontario's Northern Ontario Heritage Fund contin-

ues to promote the establishment of higher value-added activities, resource-related and otherwise, based in the north. The objective of the Heritage Fund is to diversify the northern economy and offset layoffs in mining and other resource industries. Similar measures are being taken by the federal government in its northern Ontario-based FedNor program.

2.2. The Importance Of Mining To The Ontario Economy

There are 52 operating mines in Ontario, 38 metal producers and 14 industrial mineral operations. In addition, there are 106 quarries and 3 salt-in-brine operations in the province. Minerals and metals produced in the province include nickel, gold, zinc, silver, cobalt, platinum group metals, silica, gypsum and salt. Mining takes place in all parts of the province. Northern Ontario cities such as Sudbury and Timmins are known around the world as major mining communities, and southern Ontario cities such as Windsor, Goderich, Peterborough, Hagersville and Port Colborne directly share in the wealth created by industrial minerals operations.

Ontario's rich mineral endowment and highly skilled workforce has made the province a world leader in mineral production (metallic and non-metallic) and exploration and environmental technology. The value of mineral production in Ontario in 1992 was \$4.8 billion and the sector directly employs over 30,000 workers in the province. This includes those employed in metallic and non-metallic mines, pits and quarries, smelters, refineries and head offices. Many are high paying, high technology jobs. Indirectly, re-spending of corporate and personal incomes earned by the mining industry contributes almost \$2 billion and over 43,000 additional jobs to the Ontario economy. Therefore, total mining industry production is \$6 billion and total employment level is about 73,000 jobs.

There are a number of key facts on the mining industry which are summarized below:

■ Ontario is a major producer of non-fuel minerals.

Ontario is the largest producer of non-fuel minerals in Canada, producing 1.8 times as much as Quebec, 2.5 times as much as British Columbia and 32 percent of Canada's total. Ontario is a major world producer of nickel, copper, zinc, gold, and gypsum (Table 1). Metal mining predominates in northern Ontario, while industrial minerals are mainly produced in southern Ontario.

Box 7

Economic highlights of the sector include:

- With an average wage of more than \$950 per week, people working in the metal mining industry are among the highest paid in the province.
- Metal mining adds more value per employee to its production than most other major industries in Ontario - almost twice as much as the manufacturing sector.
- Labour productivity in the mining industry has advanced more rapidly than either the manufacturing or service sectors of the provincial economy. However, there has been virtually no improvement in total factor productivity.
- The industry spends about \$50 million in research and development annually.
- About \$300 million is spent annually by the industry on environmental protection.
- The industry pays an average of about \$500 million in taxes annually.
- The industry spends about \$750 million in Ontario on supplies and services annually in recent years. This is 90% of all supplies and services purchased by the industry. \$300 million was spent within a 50 mile radius of mine sites in northern Ontario. Inco is the largest user of electricity and cement in Ontario and Falconbridge is Ontario Hydro's largest customer.

Table 1. Value of Ontario Mineral Production (Millions Current Cdn\$)

Mineral	1987	1988	1989	1990	1991
Nickel	869.3	2166.3	2010.1	1345.6	1237.7
Gold	1016.1	1002.9	1142.4	1150.3	1025.6
Copper	677.3	824.0	922.1	860.8	723.2
Uranium	581.3	523.4	550.3	627.2	165.0
Zinc	341.8	548.8	572.8	532.1	276.5
Platinum Group Metals	168.0	172.9	128.3	171.6	125.1
Other metals	387.7	305.1	243.9	195.8	178.3
Total metals	4041.5	5543.4	5569.9	4883.5	3731.4
Salt	139.3	158.4	138.5	116.7	142.6
Other non-metals	104.7	112.3	102.1	102.9	96.8
Total non-metals	244.0	270.7	240.6	219.6	239.4
Total metals and non-metals	4285.5	5814.2	5810.5	5103.1	3970.8

Source: 1989 Ontario Mineral Score, MNDM, 1991 Canadian Minerals Yearbook, EMR Canada

■ **Mining is characterized by fluctuating commodity prices.**

Mineral commodities are subject to cyclical price swings. The industry does not set prices for these commodities, prices are set on world markets. Shifts in supply, demand and inventories all affect mineral commodity prices, and are driven primarily by mineral end-using manufacturing industries and their respective

business cycles. In addition, political unrest and other uncertainties are factors affecting the supply and demand of minerals and which strongly influence the price of mineral commodities.

■ **Mining is a high-tech industry.**

According to Statistics Canada, 85 percent of Canada's mine workers use advanced technology, with high-tech equipment being used in exploration, mining, milling, smelting and refining.

Exploration and development are key to a healthy mineral sector. Exploration, the search for new deposits, is critical to the continued existence and future viability of the Ontario mining industry. Exploration success, through the development of further ore reserves at and around current mining operations, and through the discovery of new ore bodies, is essential to replace mined-out deposits.

■ **Ontario is home to some of the world's leading mining companies.**

Although approximately 161 companies are engaged in mining and quarrying in Ontario, three companies – Inco Limited, Falconbridge Limited and Noranda Minerals Inc. – account for virtually all base metal production. More than 80% of the assets of the metal mining industry and more than 75% of the assets of the non-metal mining industry are Canadian controlled.

The 1989 acquisition of Falconbridge by Noranda and Trelleborg AB of Sweden further concentrates Ontario's base metal production and

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also results in Noranda controlling all eastern Canadian copper and zinc smelting and refining. Gold production is less concentrated with major producers such as Placer-Dome, Hemlo Gold, Homestake, LAC Minerals, and Teck. In addition, 17 out of the 20 metal mining companies operating in Ontario have headquarters in Toronto.

■ Mining has spawned many businesses in mining-related services, many of which are based in northern Ontario.

The Ontario mining industry confers many value-added opportunities to upstream sectors in terms of creating employment in equipment manufacturing, material supplies and mining services, including mine engineering and consulting.

■ Many Ontario communities are dependent on mining.

Throughout Ontario are towns and villages which are dependent on mining. Examples are Kirkland Lake, Marathon, Manitouwadge, Timmins and Red Lake. A strong, well-positioned Ontario mining industry is important to sustain the prosperity of these and many other communities, particularly in the north.

■ Minerals are important inputs to Ontario's manufacturing sector.

While the majority of Ontario's minerals are exported, many are essential to the province's manufacturing sector. For example, nickel is used for stainless steel and other alloys which, in turn, are fabricated into machinery and equipment. Copper is valued for its electrical conductivity and is thus used in electrical equipment and cable and wire. Zinc is alloyed and used in galvanized and die-cast applications, particularly in the automotive sector. Gypsum's main end-use is in the fabrication of wallboard for the construction sector.

2.3. Mining's Image

As described in the earlier part of this chapter, the mining industry, while somewhat diminished in size from its former position, is a major player in the Ontario economy. In fact, measured in terms of employment or value of production, the industry is larger than either the plastics or the telecommunications industry. The mining industry is a very high tech enterprise whether viewed at the exploration, production or rehabilitation stage as seen in Statistics Canada data. Mining industry technology is uniformly leading edge at all stages of the

Box 8

Mining Investment Worldwide

Of a total US\$38 billion worldwide, \$3 billion is committed to be spent in Canada and \$433 million on Ontario.

Ontario accounts for 1.14% of worldwide and 5.84% of North American investment.

Worldwide Investment

Continent	% of Total	Millions of \$
South America	28.0%	\$10,671
North America	19.0%	7,410
Africa	17.5%	6,607
Australia	16.5%	6,257
Asia	16.0%	6,106
Europe	2.5%	949
Total	100.0%	\$38,000

Canadian Investment

Province	% of Total	Millions of \$
NWT	29%	\$900
Quebec	23%	701
Ontario	14%	433
British Columbia	13%	408
Alberta	11%	322
Manitoba	6%	187
Saskatchewan	3%	79
Yukon	1%	35
Canada	100%	\$3,065

Source: Engineering & Mining Journal

"The public view of mining is coloured by perceptions that are decades old ..."

Recommendation:

- Foster a better public perception of mining among Ontario residents through increasing the general level of knowledge about mining, particularly its high technology characteristics, its vastly improved environmental performance and its vital economic importance to Ontario's economy.

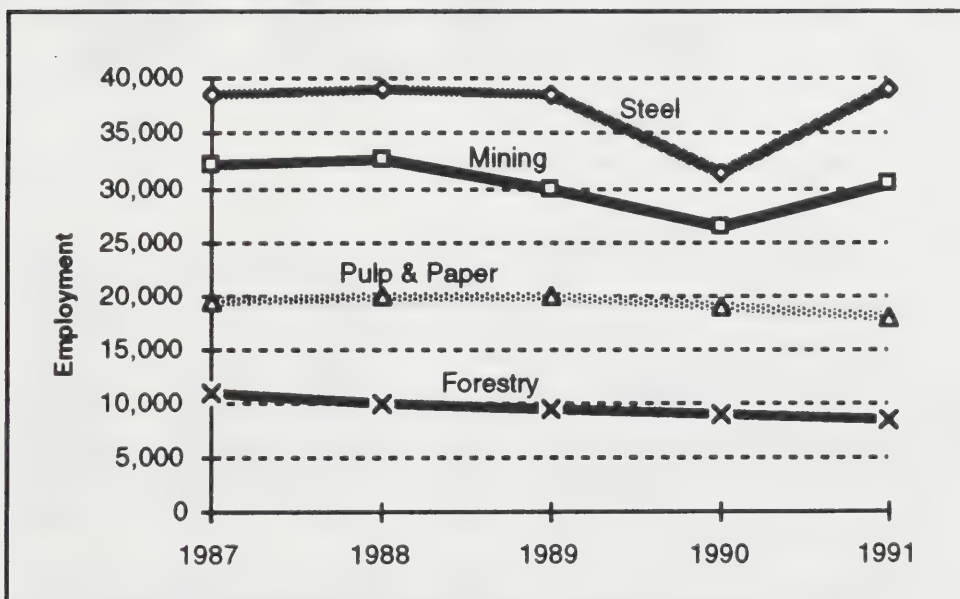
mining sequence. For example, in exploration leading edge instruments were used in the search for Skylab debris in the arctic and radio-controlled scoop-trams allow operator-less mining underground - leading edge robotics and communications technology. The industry is relatively mature, forming a well defined economic sector with well established linkages amongst its various parts. The industry has operated as a sector for some time with industry-associations championing a sectoral view in relationships with government and the general public.

But the public view of the industry is coloured by perceptions that are decades old. The mining industry is seen by many as a low tech enterprise, a despoiler of the environment, and in general a sunset industry. This perception is brought about by old industry mining methods and smelting and refining practices. Those practices were, at that time, the only available technology and society then, as now, wanted metals. The various consultation exercises embarked on in the course of this study have clearly shown that this outdated public perception of the industry is still a problem.

Fostering a better, more accurate perception of the industry has been identified through the Whitehorse Mining Initiative as a major industry priority. Means of modifying this negative public perception must involve reaching a broad cross-section of the population. A possible means of achieving this goal has been shown by the recent success of a series of television commercials developed by the Ministry of Northern Development and Mines. The commercials demonstrated the pervasive distribution of mineral products in everyday life. Follow-up polls revealed that the commercials were effective vehicles for this

type of message in southern Ontario. The conclusion to be drawn from this example is that public education efforts by all stakeholders in the sector devoted to improving the image of the industry may well be effective.

Figure 2. Ontario mining is a major employer



Source: Statistics Canada, *Employment, earnings and hours*, 72-002

3. Human Resource Issues

3.1 Training in the Industry

In the past several years, approximately 30,000 people have been directly employed by mining companies in Ontario (Figure 2). This includes those employed in metallic and non-metallic mines, pits and quarries, smelters, refineries and head offices.

Most employees in the Ontario mining industry are engaged in production-related positions, however the industry also employs a number of highly skilled engineering and research staff.

Jobs in the metal mining industry are often highly-skilled positions involving extensive training and/or formal education, with high incomes usually associated with trained, skilled employment. Training expenditures per employee increased by almost 38 percent over the last several years, reaching \$1300 for each worker (Figure 3), or more than \$26.8 million in total.

3.2. Income Levels for Mining Industry Employees

Employees of the mining industry are, on average, among the most highly paid in

"Restructuring in the mineral sector has taken the form of downsizing and mine closures."

Figure 3. Extensive training expenditures in Ontario's mining industry

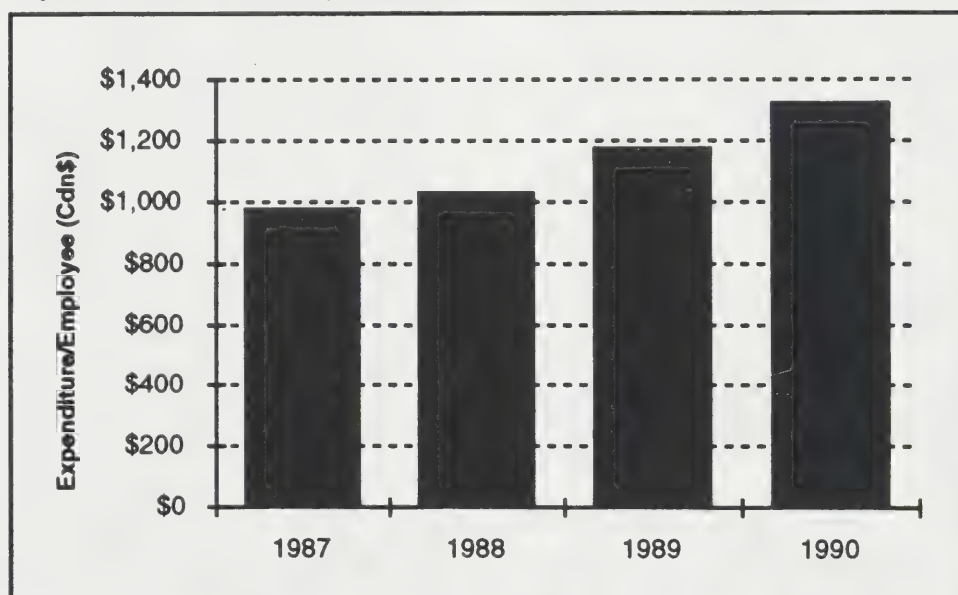


Table 2. Mining Industry Earnings and Profits

	1987	1988	1989	1990
Average Earnings	\$38,065	\$43,715	\$48,265	\$53,050
Average Benefits	\$5,705	\$7,720	\$9,915	\$10,580
Average Annual Labour Income	\$43,770	\$51,435	\$58,180	\$63,630
Average Payroll Tax per Employee	\$4,435	\$4,725	\$4,955	\$6,140
Average Annual Labour Cost	\$48,205	\$56,160	\$63,135	\$69,770
Total Ontario Earnings (\$ millions)	890.2	1042.8	1163.6	1109.9
Total Ontario Benefits (\$millions)	133.4	184.1	239.1	221.4
Benefits as share of wages and salaries	15.0%	17.7%	20.5%	19.9%

Source: Ernst & Young survey; Ernst & Young calculations

the province. Average weekly earnings for all employees were \$953 in 1991, or about 45 percent higher than the weekly average of \$657 for all manufacturing workers, and almost 33 percent greater than average weekly earnings in the motor vehicles and parts industries (Figure 3). Average annual wages in the Ontario mining industry were over \$53,000 in 1990, which reflects an average yearly increase of 17 percent since 1987 (Table 2).

In 1987, the average mining company employee also received benefits valued at almost \$10,600. Benefit payments per employee have been growing more rapidly than wages, with an average annual growth rate of 22.9 percent between 1987 and 1990.

Combining wages and benefits to yield a "labour income per employee" figure, the average mining industry employee received an income of roughly \$63,000 in 1990, which grew at an average rate of 13.3 percent between 1987 and 1990.

In 1990, average annual labour cost per employee in 1990 totalled \$69,800, including about \$6140 in payroll tax for the average worker (payroll taxes per employee have grown at an annual rate of 11.4 percent since 1987).

In total, employees of the mining industry received over \$1.1 billion in wages and salaries in 1990. An additional \$221 million in benefits were provided by mining employers, or 19.9 percent of average earnings.

"Mining employees are among the most highly paid in the province."

3.3. Labour Relations and Unionization

The largest proportion of employees in the mining industry are involved in mining production, milling, smelting and refining. The majority of the workers in this part of the industry are unionized, with the major unions being the United Steel Workers of America and the Mine-Mill Union. Several other unions represent workers in some metal mining and industrial mineral operations such as: the Cement, Lime and Gypsum WU, the CAW, the Teamsters, the Energy & Chemical Workers Union, the Boilermakers and the Base-Metal Workers Union. Although it is always difficult to generalize, the labour relations climate in the industry within Ontario is relatively mature: both industry and the unions are careful to implement change on a consultative basis. Not all production operations are unionized. The notable exceptions are the Campbell Mine in Red Lake and the Province's largest base-metal producer, the Kidd Creek Mine in Timmins.

The labour relations climate is good, with relatively few long, major strikes in the industry. For example, the last major strike affecting

Sudbury nickel production was over ten years ago.

The exploration industry consists of relatively small work units composed of relatively mobile, largely professional level employees. These factors have meant that the exploration segment of the industry is not unionized to any significant degree. The rehabilitation segment of the industry is dominated by consulting engineering firms which are largely non-union.

"Human resource development is a vital consideration in preparing a mineral sector strategy."

3.4. The High Wage – High Value Added Linkage In Mining

Mining adds more value added per employee to its production than most other major Ontario industries. For example, in 1987 (most recent year of data available), the mining industry added almost twice the value per worker as the manufacturing sector (Figure 1).

Due to the high technology - high value-added linkage in mining, human resource development is a vital consideration in preparing a mineral sector strategy. Although downsizing has created a substantial overall labour surplus within the sector, high technology skills are lacking. The concern is that a shortage in appropriate skills may inhibit productivity improvements in exploration, development, production and closure.

Restructuring in the mineral sector since the early 1980s has taken the form of downsizing and mine closures. Consequently, employment in the mining industry has decreased by about 30 percent since that time. The decline in employment is a factor which has reduced mining-related post secondary education enrolment and training activity by mining companies.

3.5. Major Human Resource Challenges facing the Mining Industry

The major influences on human resources in the mining industry are technological change, increased environmental regulation, and changes in corporate management philosophy and practises. With respect to the latter, management is now moving towards more employee involvement in problem-solving and decision-making to achieve continuous improvement. Demands for increased technical skills are now being matched by needs for increased skills in the areas of communication, coaching and other interpersonal skills.

Given the trends towards high technology and interpersonal skills development noted above, a number of needs among the various

occupational groups in the mining industry have been identified by industry and labour. These include:

- Higher skill levels in literacy, numeracy, computers, science, problem-solving and decision-making, among operations and production workers
- Higher levels of skill in electronics, troubleshooting, computers, problem-solving and decision-making among those employed in the trades.
- Higher skills in environmental awareness and in the ability to create a better climate of continuous improvement are required among the industry's technical, professional and managerial staff.

Other issues impacting across all the occupational groups in the mineral sector include:

- The industry has an aging workforce, with little turnover, and little hiring.
- The industry is dominated by men. Women comprise only 10 percent of the workforce and they are found in mainly clerical positions.
- Aboriginal people are concentrated primarily in unskilled and semi-skilled positions.

The industry's human resource management and development strengths include:

- Decentralization of Training – ensuring that training activities are driven by the needs of the operation.
- A strong “workers training workers” culture, involving workers in the design and development of most training programs.
- Trainer selection based on communication skills, not just on technical skill.
- On-going development of technical, professional and managerial staff

The continued development of the present workforce is a critical issue, as many of the people who will be working in the industry in the year 2000 are working in the industry today. Therefore, the following major human resource challenges require attention:

Rediscovering our Resources:

- Workforce dislocation and adjustment
- The need for basic skills upgrading
- The need for continuous learning and continuous improvement by all employees
- More technical training in the trades – the need for occupational standards for operations/production occupations.
- Under-representation by women and limited employment opportunities for Aboriginal people.
- Low enrolment in mining-related post-secondary programs.

It should be noted that the level of professional training offered in Ontario post-secondary institutions is among the best in Canada. Some schools specialize more on certain aspects of mining such as hard rock mining (Western, Queen's, Toronto, Ottawa, Laurentian and Lakehead) while some schools are more environmentally or geochemical oriented, like Waterloo, McMaster, Carleton, Guelph, York and Windsor). In general, schools offering more hardrock are attracting relatively fewer students as are those offering more environmentally-based course work.

Cambrian College in Sudbury and the Haileybury School of Mines in Haileybury are the two community colleges in Ontario which offer specialization in mining technology. Both colleges concentrate on applied curricula that involve training on how to use instruments or on skills directly applicable to the industry, such as mapping, drilling and mine geology. There is a need for professional level training to improve exploration technology. There is a further need for technical training in various areas of mining technology.

3.6 Improving Health and Safety Through Technology

In addition to technical and professional development matters, increased research is required in the area of mining health and safety. The Geomechanics Research Centre at Laurentian University aims to be among the foremost geomechanics engineering research organizations in the world. The GRC contributes directly to safe and productive mining through focused research on problems facing the mining industry (Box 9)

Box 9

The Geomechanics Research Centre at Laurentian University

The Geomechanics Research Centre at Laurentian University conducts a research program designed to maximize stability of underground mining excavations, ensuring safe and efficient mining. It is proposed that a joint university-government-industry research fund for the Centre's program be established. The Centre's programs include those with environmental benefits such as using tailings (mine waste) as backfill underground following extraction of ore, research on rockbursts and cable bolting to ensure stability and safety of underground openings.

The research programs have produced safer working conditions in Ontario mines. Results are being applied in joint projects with overseas research partners.

The Ontario government has invested in the formation of the GRC through a grant to establish the Chair for Rock Mechanics. The mining industry funded a multi-year research program for the first five years of the Centre's existence. This industry investment can be capitalized upon by Provincial funding to match the industry funding commitment for the next five years. It is proposed that each dollar of industry funding be matched up to a maximum of \$500,000 over three years. When combined with available university-based fund-matching programs, a true university-government-industry funding partnership will ensure the future of the Centre for some time.

Recommendations:

- Ensure excellence in professional and technical training, both institutional and company-specific, to meet the changing needs of the present and future workforce.
- Provide access to better mining-related training opportunities by Aboriginal people and women.
- Promote higher levels of applied R&D and more technology transfer opportunities in the area of mining health and safety.

The mission the GRC is to be among the top engineering research, development and technology transfer organizations contributing to the safe and productive use of Canada's underground space. In order to do so, the GRC has developed a business plan outlining industry commitments to this effort, and a proposal for funding through the Sector Partnership Fund.

4. Outlook and Opportunities

World markets are important for raising mining capital and selling Canadian minerals and mining-related products. Therefore, knowledge of the major trends affecting these markets is important to ensuring a better understanding of the broad forces acting on Ontario's mineral sector. This section outlines the major trends and highlights strategic opportunities in the mineral sector's main components or "sub-sectors" – exploration and development, production, mine closure, and mining equipment manufacturing.

4.2. Mineral Exploration and Development

Mineral exploration is the critical upstream activity to mine development and mineral production. Exploring for new reserves⁴ around current mining operations and discovering new economically viable mineral deposits are critical factors in sustaining the mineral sector, its employment base, and contribution to the Ontario economy over the long term. As exploration is a key upstream activity within the mineral sector, facilitating mineral exploration in the province continues to be one of the highest strategic priorities of Ontario's Ministry of Northern Development and Mines.

Replenishing Ontario's mineral reserves requires continuous investment in mineral exploration. As exploration is a very costly and highly speculative activity, mineral investment capital is scarce and is raised mainly through world equity markets. Attracting highly mobile international investment for mineral exploration is therefore critical to replenish Ontario's diminishing reserves of nickel, copper and zinc (Figure 4).

If Canada's reserves are not replenished adequately, the Government/Industry Task Force on Mineral Investment Climate warns that the mineral sector in Ontario and the rest of Canada could decline dramatically, causing significant negative impact on the provincial economy and the many Ontario communities that depend on mining for continued health and prosperity.

The competitive predicament Ontario and the rest of Canada finds itself in is that base metal reserves have been on the decline for almost a decade. However, there is concern that Canada may no longer be

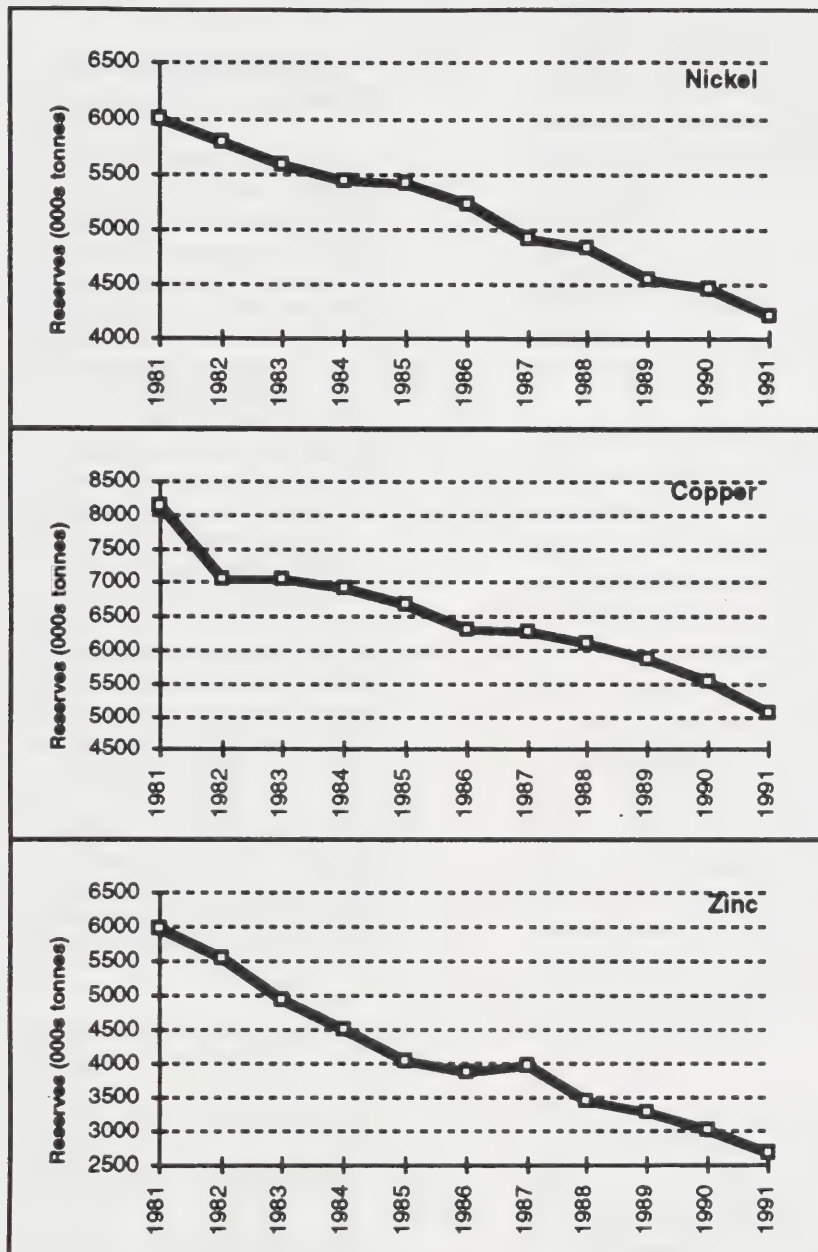
Box 10

Global Trends

For mining, the most important recent global trends have been:

- Increasing global concern for the protection of the environment, exemplified by the United Nations Conference on Environment and Development, held in Brazil in June, 1992.
- Technological innovation, particularly in the area of telecommunications, which is diminishing the effect of political and geographic boundaries.
- The acceleration of globalization processes, marked by the increasing mobility of capital and the shifting of value-added manufacturing to developing countries. Some developing countries have experienced much higher growth rates than the OECD countries.
- The movement toward market-driven societies, marked by German unification and the fall of the Soviet Union as examples. These events set the stage for possible fast change, new markets and new sources of mineral wealth. There is high potential for accelerated political turbulence and potential supply disruption in areas of the world such as the former Yugoslavia and former USSR.
- The impact of changing world trade patterns, exemplified by free trade between Canada, the US and Mexico, and developments in Eastern Europe. These will have a significant effect on mineral producers and downstream users of mineral products.

Figure 4. Ontario base metal reserves are in decline



- 4 A "mineral reserve" is a function of the physical characteristics of a mineral deposit, its location, cost/price relations and interest rates.

When interest rates are high, mineral producers will reduce exploration costs, which will tend to keep inventories low, similar to "just in time" inventory management practices in other businesses.

among the prime areas for mineral investment, as Canada has recently dropped from first to third in terms of the countries that attract most world exploration investment (Box 11).

There is a wide perception that legislative and policy changes introduced in a number of mineral-rich countries, particularly in Central and South America, have released a pent-up demand for high quality mine development opportunities and have significantly impacted global mineral investment flows, including those of Canadian exploration firms. Presently, 20 percent of Canadian firms' exploration budgets are targeted for other countries. This percentage is expected to increase.

The reasons for this growing interest in out-of-Canada mining activity is likely related to the perception that Canada's most easily accessed high grade mineral deposits have been largely discovered and developed over the past century and that subsequently, new discoveries will likely be deeper, more inaccessible and hence more costly to find, in contrast to the relatively better mineral opportunities in Latin America.

The movement away from Canada is also likely rooted in industry perceptions that Ontario and other Canadian provinces are becoming increasingly high cost mining jurisdictions, due to assumed uncertainties in land access and tenure matters, and in the way environmental regulations are

developed and coordinated. Improving these perceptions in order to attract investment back to Canada is a concern to government and has been given a high priority by Canada's provincial, territorial and federal Mines Ministers through the "Whitehorse Mining Initiative"

Clearly, exploration and development costs are climbing, and discovering more efficient ways to explore for and bring new mines into production through strategic partnerships and technological achievement and innovation is essential. Toward this end industry has formed an exploration research consortium – the Mineral Industry Technical

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Council of Canada. Meeting these technological demands to keep exploration costs down continues to present a major challenge to the sector, and will require an increase in collaborative exploration research efforts. In order to meet these demands efficiently, new mineral sector exploration research efforts could be concentrated or clustered in Sudbury, which is located in one of the largest mining regions in the world. The advantages that the Sudbury area has in fostering higher levels of exploration research are:

- The concentration of Inco and Falconbridge operations in Sudbury, providing access to world-renowned exploration and development expertise.
- The recent relocation of MNM to Sudbury, including Ontario Geological Survey staff. The OGS is renowned for its expertise in exploration matters. OGS staff have been accommodated in a new state-of-the-art research facility built on the campus of Laurentian University. The overall staff relocation effort has been designed to encourage greater levels of collaboration between academe and government in exploration and development matters.
- The Laurentian University infrastructure. Through a strengthening of the university's post-graduate programming in Geology, the university offers the potential to form better partnerships with other Ontario colleges and universities, and to draw researchers from major academic institutions around the world to Sudbury.
- The Cambrian College infrastructure. Cambrian College in Sudbury and the Haileybury School of Mines are the two community colleges in Ontario which offer specialization in mining technology.

4.3. Mineral Production, Refining and Smelting

Ontario is among the top ranking producers of nickel, copper, gold and zinc. The following highlights trends in the demand and supply of these and other Ontario minerals and provides an outlook towards the year 2000. This section discusses seven of Ontario's major metals and industrial minerals in terms of world demand, demand outlook, Ontario supply outlook, mine production and smelter refinery production, and overall competitiveness.

4.3.1. World Demand for Ontario Minerals

Key points on the source of world demand for Ontario minerals:

Box 11

Trends in World Exploration Spending

The September/October 1992 Metals Economics Group Strategic Report noted a downward trend in exploration spending with a net decrease of \$96.4 million between 1991 and 1992. A survey of 161 exploration companies representing 80% of nonferrous metals exploration was conducted. Together, these 161 companies' 1992 exploration budgets totalled \$1.7 billion, with \$363 million directed to projects in the United States (21.4%), \$324 million to Australia (19.1%), \$302 million to Canada (17.8%), \$256 million to Latin America (15.1%) and \$453 million elsewhere (26.2%). Comparative figures show that spending in the United States has increased by 6.5% over 1991 levels, while Latin America shows an increase of 28%, Canada a decrease of 30%, Australia a decrease of 8%, and the rest of the world a decrease of 13%. Latin American spending is focused largely on Chile, Brazil and Mexico.

Recommendation:

- Assist in replenishing Ontario's known mineral reserves, by promoting dialogue on mining sector issues and advancing land-use policies which recognize the importance of mineral development to the Ontario economy.

Box 12

A Proposed Mineral Exploration Research Centre

The depletion of base-metal reserves in Ontario requires more exploration expenditures and greater effectiveness in the exploration process.

Laurentian University has proposed a Mineral Exploration Research Centre as an industry-government-university partnership designed to increase the effectiveness of exploration for mineral deposits.

The Centre, associated with the Laurentian University Department of Geology, would be staffed by a Director who is a senior expert in mineral deposit geology in the Canadian Shield. Research would be funded by the mining industry and other funding sources, and aimed at increasing the effectiveness of exploration.

This model, with industry-funded exploration research conducted at a university, has been very successful in Australia where several exploration innovations have been developed.

Among the benefits of the proposed Mineral Exploration Research Centre:

- Increased exploration expenditures in Ontario
- Increase effectiveness of Ontario exploration
- Increase home base activities of the largely Ontario-based Canadian exploration industry
- Increase networking amongst exploration firms through joint sponsorship of research projects
- Increase the skill levels of explorationists
- Develop exportable exploration methods
- Develop economic spinoffs through method development and research expenditures for supplies and salaries in Ontario.

Europe

Europe is considered the world's most significant global trading area, and Canada is one of its main suppliers. The industrialized countries in Europe are dependent upon mineral and metal imports to meet the demands of its manufacturing industries. Continued integration of the European market place will no doubt become a new source of competition but will also provide new opportunities to Ontario. While overall, the Canadian share of the EC's principal refined metal imports declined during the 1970s and 80s, the EC increased imports of Canadian gold and has remained the largest outlet of Canadian nickel in all forms.

The Former USSR

This region is one of the world's leading producers of nickel, gold, platinum and base metals. Currently there is a trend toward increased export of its minerals and metals to generate badly needed foreign exchange, and dumping of nickel, copper, aluminum and uranium by Russia is largely responsible for the current low price of these metals on world markets. Over the long term, modernization will lead to more efficient production of minerals and metals from the region and could further upset the balance in world supply. In terms of developing its mineral potential, the region will be encouraging more joint venture operations which provide needed advanced technology and processes from the West. Strategic alliances are expected to provide Canadian mining and service companies with a share in future development occurring in the former USSR and the transformed European bloc.

China

The Chinese non-ferrous metal industry is still struggling. Shortages have been noted in copper, lead, zinc, tin, titanium, and nickel, to name a few. China follows a policy of import substitution with respect to many mineral products, to build up their own domestic industry. As such, aside from isolated circumstances, China offers little opportunity for Canadian producers, in the medium term.

North America

North America is the second major trading area and the US is Ontario's principal export market. Up to now, Ontario mineral producers have been absorbing relatively low US tariffs. With the onset of freer trade between the two countries, major layoffs and other dislocation problems have occurred in many sectors across the province. However, mineral producers may be able to offset some of these problems by seizing new opportunities to raise value-added potential in the

primary processing stage of metal production. Further processing opportunities may raise interest in additional research and development in mineral-processing technology. Indications are that new opportunities in product specialization exist, in areas such as ferro-alloys, silicon metal, zinc alloys, certain molybdenum compounds, gypsum products, nickel products and rock and mineral wools for insulation. Also, the potential to increase our export of engineering and consulting services should stimulate Ontario's interests in investing in geoscience, mineral extraction, and processing in order to export specialized services to the US and abroad.

4.3.2. World Mineral Demand Outlook

World mineral demand outlook is analyzed in terms of commodities for which there is significant Ontario production and reserves. Details of the uses, growth of consumption, and vulnerability to substitutions are shown in Table 3.

Major strategic considerations with respect to the demand outlook are:

- Continuing uncertainty regarding international demand for the major metals produced in Ontario: nickel, copper, zinc and gold. Ontario does not set prices for these mineral commodities. They are set internationally, on highly volatile markets.
- Continuing domestic demand for high volume, low unit value Ontario-produced gypsum and salt.

Current nickel market uncertainties are brought about by price competition from Russia which has resulted in downward movement of nickel, copper, aluminum, and uranium prices. Developing countries such as Brazil, Taiwan, South Korea, and India are rapidly increasing their investment in power distribution and telecommunications networks. Their development of light industries as well as their entry into early stages of auto production have significantly boosted their share of world copper consumption.

Zinc usage has gone down with the increased substitution of plastic for zinc die casting in automobile manufacturing. The demand for gold in carat jewellery is almost entirely confined to the developing world. Electronic uses of gold continue to increase in the US and Japan.

Ontario uranium production will cease in 1996 when Ontario Hydro's contract with Rio Algom terminates, the province's only uranium producer. The high grade deposits of Saskatchewan are the main competitive factor. No comparable deposits are likely to be found in

*"It's no secret that nickel is
the metal of the new
economy..."*

*Nuala Beck, Shifting Gears:
Thriving in the New
Economy*

Table 3. World mineral demand outlook

Commodity	Uses	Growth of Consumption	Region of Consumption	Remarks
Nickel	66% Capital goods (stainless steel, buildings, machinery) 25% Consumer goods (refrigerators, cutlery, sinks) 10% Automotive	+6% developing countries +0.9% western countries	65% industrialized countries 25% centrally planned economies 10% developing countries	Declining intensity of use through substitution of materials
Copper	16% building wire 16% plumbing & heating 8% telecommunications 7% power utilities 7% in-plant equipment 7% airconditioning 4% automotive	+4% Japan +2% Germany and U.S. +1% industrial countries	60% electric wire & cable producers: U.S., Japan, Germany 20% developing countries	1. Substitution of aluminum, plastic fibre optic cables 2. Declining intensity of use over last 20 years has recently stabilized
Zinc	Galvanized steel brass production	+1.7-2.0% western world 1.5-2.2% world	Largely western world	Decline in consumption through less zinc die casting in autos
Gold	64% Carat jewellery 20% bar hoarding 6% electronics	18% developing countries 4% industrialized countries	Disproportionate share in developing countries	
Uranium	>90% Power generation; other minor uses: aerospace, radiation shielding		Developing countries	Demand dampened by environmental concerns No Ontario production after 1996
Salt	50% Industrial chemical 45% deicing minor, food, etc.	Minimal	Regional domestic market, some exports to U.S.	Low unit value commodity
Gypsum	66% Wallboard, 19% portland cement, 4% agriculture	+2.6%	Developed countries dominate	Low unit value/local market; depends upon health of construction industry

Ontario, therefore closure of the Elliot Lake deposits likely spells the end of Ontario uranium production for some time.

Salt and gypsum are low unit value commodities which are sensitive to the cost of transport to market. Thus, the major export market for salt and gypsum is the USA. While the Canadian chemicals sector has increased its salt demand 2.5 times since 1971, the US chemical industry's salt consumption has fallen 61 percent in 1980 to 47 percent in 1988.

4.3.3. Ontario Mineral Supply Outlook

The commodity-based Ontario mineral supply outlook is summarized in Table 4 showing details of the reserves available at current production levels. Most mines do not usually have reserves very far in advance of production. For example, many gold mines at any given time show only three years worth of reserves. Therefore the 30 year reserve figure for nickel, and the 20 year figure for copper clearly indicate there is not a near term problem for these metals. Over 70 percent of Ontario copper reserves are accounted for by the nickel-copper orebodies in the Sudbury district, with a further 25 percent accounted for by the Kidd Creek zinc-copper orebody in the Timmins area. While reserve depletion and resulting job loss is a major threat to Timmins, on a provincial scale there appears to be little constraint to Ontario's copper production through to the next century. However, Ontario zinc reserves are sufficient for only about 10 years production, largely derived from the Kidd Creek deposit in Timmins. Over 60 % of the province's zinc is contained in the Timmins Kidd Creek orebody. This is a clear example of the importance of renewed attention to exploration for new deposits within Ontario.

"Reserve depletion and resulting job loss are major threats to Timmins ..."

Ontario gold reserves are dominated by the three Hemlo mines which comprise 55% of Ontario's gold reserves. The Hemlo discovery and other activity in the 1980s represented a tripling of Ontario's gold reserves. The Campbell Mine in Red Lake accounts for an additional 15% of current reserves. The remaining reserves are scattered amongst a number of smaller producers.

The mine life of many of the smaller operations is less than 10 years, but the potential for discovery of nearby small deposits is considered high.

Over the long term, gypsum resources in the Moose River basin in northern Ontario may be developed. The relatively remote location suggests that high

Table 4. Ontario mineral supply outlook

Commodity	Reserves	Location	Remarks
Nickel	>30 Years	>95% Sudbury	Reserves will not constrain future output
Copper	~20 Years	70% Sudbury-type deposits 25% Kidd Creek deposit	Declined slightly faster than nickel reserves
Zinc	<10 Years	60% Kidd Creek deposit	Major exploration effort required to identify new reserves
Gold		55% Hemlo 15% Campbell Mine, Red Lake	Has increased rapidly, tripled 1981-88
Salt	Abundant	Southern Ontario	Low unit value, adequate supplies
Gypsum	Up to 75 Years	Southern Ontario	Low unit value, adequate supplies

value-added gypsum products for pharmaceutical and speciality uses would be the major viable products from these deposits.

Replenishing mineral reserves requires renewed high intensity exploration for new deposits. Promoting excellence in exploration and higher levels of investment in exploration are critical to discovery of new reserves.

Upon the depletion of the Kidd Creek deposit, if no small orebodies are in production and if no major discoveries are made, Ontario's only producing mines may in future be at Sudbury, Hemlo and Red Lake – a clear indication of the magnitude of the reserve problem.

"Inco is completing the single largest environmental project ever undertaken by a mining company"

4.3.4. Mine Production and Smelter/Refinery Production

Nickel

Nickel-copper ore is mined by Inco Ltd. and Falconbridge Ltd. in the Sudbury District. Currently, a total of 16 mines are operated by these two companies.

Milling facilities for the major nickel-copper producers (Clarabelle – Inco and Strathcona – Falconbridge) have been modernized recently. Inco has available 40,000 tonnes capacity per day (Inco's capacity is constrained at this level to meet provincial sulphur dioxide emission standards) and Falconbridge 10,000 tonnes. Both companies have smelters located in the Sudbury region.

Inco is investing heavily to reduce its sulphur dioxide emissions and has nearly completed the single largest environmental project ever undertaken by a mining company. It has constructed new flash smelting furnaces, a new sulphuric acid plant, and a new extension to the oxygen plant. Total investment is in the area of \$Cdn530 million and completion is anticipated in January, 1994. Additional investment is also occurring in the modification of milling procedures to improve the grades of nickel and copper concentrates. Falconbridge is also investing in reducing sulphur dioxide emissions. Inco's refinery capacity amounts to 52,500 tonnes of nickel pellets per year for its Sudbury refinery and 30,000 tonnes per year at its Port Colborne facility. Falconbridge has no Canadian nickel refining facilities. Falconbridge ships nickel matte to its refinery in Norway.

There are no plans to increase nickel smelting and refining capacity in the province. Rather, both companies have comprehensive mine development programs in place to maintain the level of feed in their processing facilities.

Copper

Copper smelters are operated by Falconbridge Ltd. at its Kidd Creek Division in Timmins and by Inco Ltd. at Sudbury. Falconbridge also has a nickel-copper smelter in Sudbury. Copper refineries are operated by Falconbridge at Timmins and by Inco at Sudbury. With the exception of copper from Inco, copper production at both the mine and refinery level is now effectively controlled by Noranda, as a result of its 50 percent acquisition of Falconbridge in 1989.

If Ontario maintains a competitive production cost position, compared with other major producers, the province should be able to maintain its share of international copper markets through the 1990s.

Zinc

There are only three principal zinc mines in Ontario, and production is dominated by the Kidd Creek operation of Falconbridge. The annual rated capacity of the Kidd Creek zinc refinery is 138,000 tonnes per year.

Historically, the greater proportion of concentrates from the smaller zinc-copper mines has been processed by Noranda in Quebec. Since Noranda now controls mine output and zinc refineries in both Ontario and Quebec, some rationalization of concentration shipments between the Ontario mines and the two refineries will likely take place.

Given the historical decline in Ontario's zinc reserves and the dominance of the Kidd Creek ore body with its less than ten year reserve, there is a clear need for exploration specifically for zinc to maintain zinc concentrate production. The presence of the Kidd Creek smelter/refinery, however, may assure the continued production of refined zinc, whatever origin of the feed material, since it is relatively modern and efficient.

4.3.5. Ontario's Competitiveness in Mineral Production

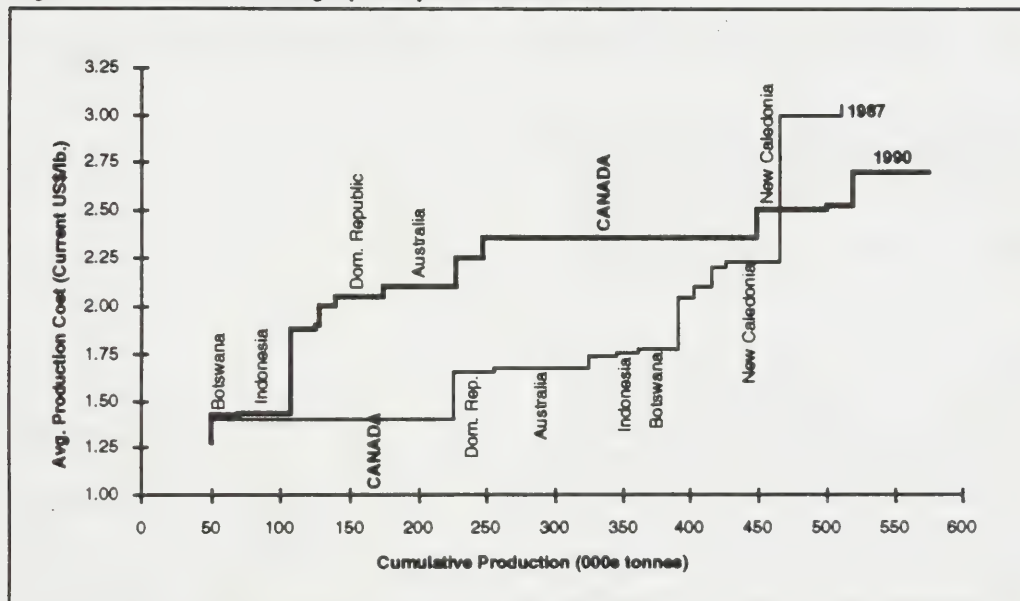
A principal factor which determines profitability is the grade of ore mined. The nickel producers in the Sudbury area, the Kidd Creek copper-zinc operation at Timmins and the gold producers at Hemlo and Red Lake have reserves which are sufficiently high grade to provide them with a strong competitive position, in terms of direct production cost.

"Competitive advantage will come from new reserves, new products and low production costs."

Nickel

Mining and milling account for the largest proportion of production costs (65 percent of total operating expenditures). Three of the largest determinants of direct cost are salaries and wages, overall mine development costs and the strength of the Canadian dollar, relative to its US counterpart. Modernization measures used over the last several years include increased capital intensity, the closure of higher-cost mining operations, a conversion to more efficient mining methods, and the modernization of mining and processing equipment. Ontario nickel producers have active research and development programs with the general objectives of improving productivity, increasing the recovery of metals, improving the safety and work environment of operations, controlling emissions and developing and marketing value-added nickel products. Nonetheless, nickel is moving up the production cost curve as shown in Figure 5.

Figure 5. Nickel is moving up the production curve



Source: Intergovernmental Working Group Report to Mines Ministers Conference, Sept. 1992

In terms of comparison with benchmark competitors, the direct cash cost for Ontario nickel mining is higher than in Australia, but significant co- and by-product revenues improve competitiveness in Ontario. Expenditures for basic research and development, exploration and implementation of technological advances are absolutely necessary to ensure the long term viability of the industry.

In addition, research and development, aimed at value-added products, is

likely to be continued by Ontario nickel producers. For instance, Inco recently expanded its research centre in Mississauga.

Copper and Zinc

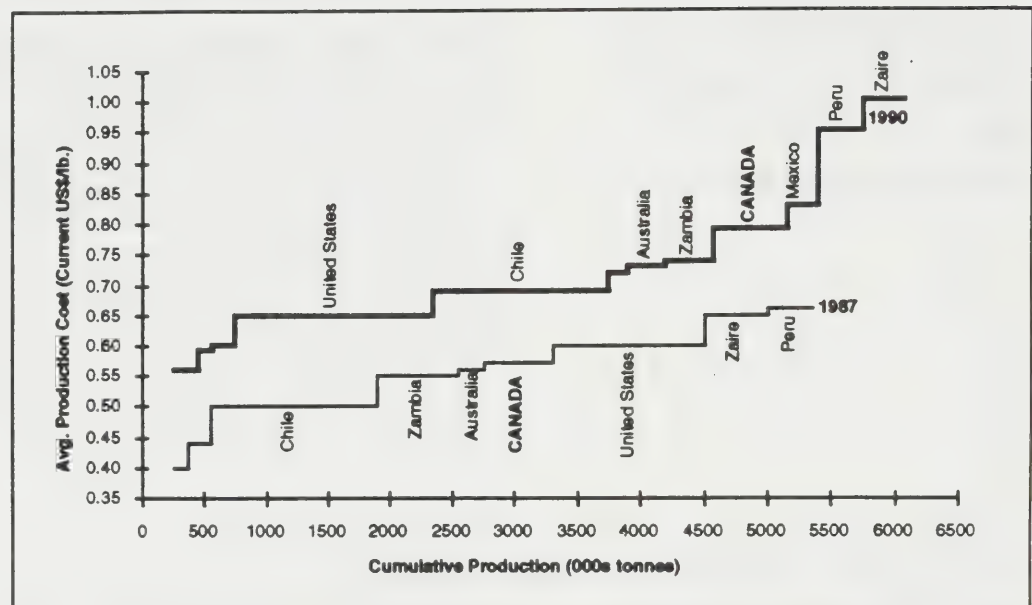
Copper-zinc production is obtained primarily from the large, high grade Kidd Creek ore body located near Timmins. This ore body is an efficient, low cost producer. Ontario copper-zinc producers have similar R&D objectives to those of the nickel industry - improved productivity in underground mining operations, improved metallurgical performance with an emphasis on environmental protection and on

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the recovery of platinum group metals, cobalt, gold, silver and sulphuric acid, all co- and by-products of copper-zinc production.

Ontario's copper production cost is likely to be under the Canadian average, but is somewhat higher than the costs experienced by other producing nations, notably Chile. However, like nickel, Canada's position on the copper production cost curve is getting worse as illustrated in Figure 6.

Figure 6. Canada's position on the copper production curve is getting worse



Source: Intergovernmental Working Group Report to Mines Ministers Conference, Sept. 1992

Zinc production costs are competitive with other producing countries such as Australia, the former USSR, China, Peru, and the US. Ontario's competitive advantage in zinc is due largely to the high grade deposit and its co-product nature with copper.

Gold

Ontario by itself is the seventh largest gold producer in the world. Ontario produces 45 percent of Canada's gold, 50 percent of which comes from the Hemlo gold camp, near Marathon. The three Hemlo producers alone produce two percent of the world gold supply. In Ontario, the utilization of the latest technological advances in gold mining and processing keeps costs low. This, in addition to the fact that Ontario hosts 5 out of the 10 highest grade gold deposits in the Western World, gives it the distinction of having the world's lowest direct cost of gold production. However, Ontario R&D in gold mining is low compared to efforts undertaken in South Africa and the US. A consistent record of exploration success has enabled Australia and the US to displace Canada in world gold production rankings.

Salt

Salt is produced in Ontario by three companies operating two rock salt mines and three brine fields. These companies work salt beds that extend from Amherstberg, northeast to London and Kincardine. Salt beds which underlie much of southwestern Ontario are thick and permit low-cost underground mining and brining operations. The

Ontario salt industry is reasonably active in research and development and future R&D programs and technological applications will probably focus on improved mine productivity and cost control in a stable economic environment. Ontario is the largest salt producer in Canada, and Ontario's salt industry is well established within its defined market area which includes the northeastern US.

Gypsum

As in salt, no major competition is expected within its regional market. Potential competitors are located outside Ontario's regional wallboard market in eastern Canada and the northeastern US. Research and development programs focus on the identification of new building product areas and specialized value-added products.

4.3.6. Summary: Opportunities and Challenges for Ontario Mineral Producers Toward the Year 2000

Key conclusions from this section are:

- Both the demand and supply of Ontario minerals will continue to be guided by the global environment and its effect on commodity markets in the years to come.
- Process-related R&D will be an on-going requirement to maintain cost-competitiveness.
- Competitive advantage will come from new reserves, new products and low production costs, which will all help to increase exports.
- Industry and government must be effectively organized to seek out and capitalize on new value-added opportunities for metals and industrial minerals
- Environmental factors continue to dominate the research agenda in the milling and smelting phases of mining.
- Continued recycling, skills training and marketing also offer expanded opportunities for the industry.
- Industrial minerals have a wide range of opportunities in the chemical, manufacturing, advanced materials and construction sectors. All sectors offer good import substitution and export prospects.
- Building stone.

Recommendation

- Promote increased consultation between industry, labour, government, communities and other sector stakeholders in order to strengthen existing partnerships in the sector and to determine specific value-added R&D priorities for Ontario. More strategic linkages should be made between the mineral sector and those sectors which are present and future end-users of metals and mineral products.

4.4. Protecting the Environment: Recycling, Pollution Abatement, Mine Closure and Mining Lands Rehabilitation

Recycling of scrap metal is a cost-efficient and environmentally sound approach to increasing the supply of mineral resources. Examples include recycling of nickel in stainless steel, and platinum group metals in spent automobile catalytic converters. The other economic benefit of recycling is that it reduces the investment to find other means of waste disposal and control.

The legislation governing the reduction in sulphur dioxide emissions from Ontario smelters – primarily in Sudbury – has stimulated research on the smelting process. Research done by Inco holds promise of new processes that could be applied in other countries faced with similar environmental problems, especially Eastern Europe and the former USSR.

In addition, Ontario is in the process of implementing new “state of the art” legislation in the area of mine site rehabilitation. This new legislation affects all proponents of advanced exploration and mining in Ontario. Other jurisdictions are currently examining Ontario’s new Mining Act for application elsewhere in Canada and in other parts of the world.

In addition to the legislative leadership shown by the Province in this area, Ontario is a world leader in the development and application of effective and efficient technologies, techniques and processes for the rehabilitation of industrial lands, including those affected by mining.

This potential is perhaps best exemplified by Inco’s research in SO₂ abatement technology and by the recent international recognition given to the Region of Sudbury for land reclamation efforts jointly undertaken over the past 10 to 12 years by industry, government from all levels, and universities. With respect to the latter, a United Nations Local Government Award was presented to the Region at the United Nations Conference on Environment and Development (UNCED) in Brazil in June of 1992 (Box 4).

The international attention paid to Sudbury’s land rehabilitation efforts is a clear reflection of a growing international concern about industrial lands rehabilitation, and the need to document and emulate proven successes, such as Sudbury’s, for the benefit of an increasingly large international community.

Global demand for land rehabilitation technology and services has significant implications for Ontario’s economic development. Export-

“Ontario is a world leader in developing new industrial lands rehabilitation technology.”

able, or tradeable services are highly desirable forms of economic activity. Mine site rehabilitation consulting activities are economically sustainable, and are high wage, high value-added activities, strongly complementing Ontario's new industrial strategy.

In addition to building up Ontario's international export potential, it is important to recognize that the Ontario Government and Ontario's mineral producing industry have distinct needs for research into mining lands rehabilitation. The Government of Ontario's needs focus on ensuring that, upon closure and legal abandonment of Ontario's present and future mine sites, all sites undergo effective long term management to avoid further public health and safety and environmental liability accruing to the Province. A related provincial thrust in this area is to ensure that financial assurances collected by the Province from mining proponents in this regard, are managed and disbursed properly, for long term site stability and rehabilitation purposes.

Recommendation

- Encourage excellence in applied research and improve business development opportunities in mining lands rehabilitation and other environmental matters by encouraging greater international networking and capacity-building.

On the other hand, the needs of the mining industry focus more on one specific thrust: the need for substantial improvements in mining lands rehabilitation technology, to comply with environmental rehabilitation legislation in the most cost effective manner possible.

Developing cost effective technology is a significant market opportunity for Ontario firms. Promoting technological advances in this area, particularly in northern Ontario, will avoid the need to import these services, and will enable local land rehabilitation problems to be solved by local experts.

4.5. Mining Equipment and Services

The mining equipment industry is composed of developers and manufacturers of equipment used by mining companies for the exploration, development and operation of mines, as well as for concentrating, refining and smelting mined material.

In 1990, the Canadian mining equipment manufacturing industry consisted of approximately 175 establishments, located in Ontario (53 percent), Quebec (20 percent) Western Canada (24 percent) and Atlantic Canada (3 percent). These firms employed about 4100 people, 50 percent of which were located in Ontario. Most companies have fewer than 50 employees. Companies supplying equipment and services to the Canadian mining industry can be divided into two groups:

- Those that have a worldwide production mandate for the goods they

"Canadian mining equipment manufacturing activities have been eroding over the past few years."

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manufacture. These represent about 20 percent of the Canadian market in terms of sales and account for most of the exports. The majority of these companies are Canadian-owned.

- Branch plant operations primarily involved in pre-sale assembly of imported components and materials, with assembly and manufacturing value-added completed in Canada.

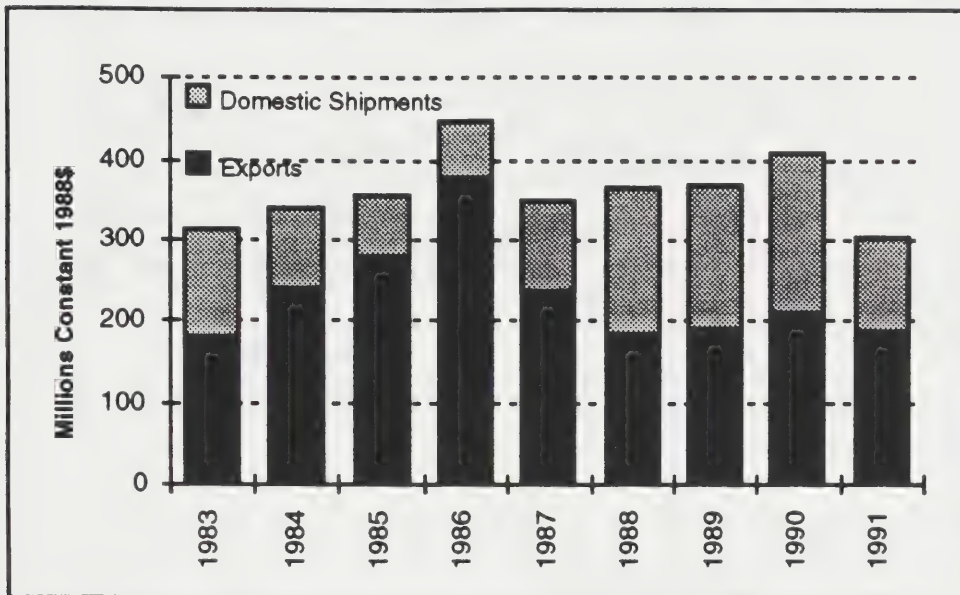
Summary data on the major companies supplying drilling, loading, hauling and utility vehicles to the Canadian market is presented in Table 5.

The production of mining equipment in Canada between 1983 and 1991 varied between \$300 million (1983 and 1991) and \$450 million (1986) (Figure 7).

Table 5 Supplier/Manufacturer Relationships and Products

Canadian Supplier	Manufacturer	Equipment	Affiliations
THE ATLAS COPCO GROUP			
Atlas Copco	Atlas Copco, Sweden	drills	
Kenroc	Kenroc, North Bay	bits and steel	
Blackwood Hodge	Wagner, US	scoop trams	
THE INCO GROUP			
Continuous Mining Systems	Montabert, France	drills	
	Continuous Mining Systems, Sudbury	drills	
	Clayton, UK	locomotives	
	Continuous Mining Systems, Eagle, US	locomotives	
JCI	JCI, US	jaw crushers	
Automated Mining Systems	Automated Mining Systems, Sudbury	mine automation	
LHD	LHD, North Bay	hydraulic systems	
Dynatec International Ltd.	Richmond Hill	contractor	
THE TAMROCK GROUP			
Tamrock Loaders	Eimco Jarvis Clark, Burlington	scoop trams	
Tamrock Loaders	Toro, Finland	scoop trams	
Tamrock	Tamrock, Finland	drills	
Tamrock	Secoma, France	drills	
Sandvik		bits and steel	EM France Loader, Finnminers Group
Wajax Industries	Getmann, US	utility vehicles	
	Voest-Alpine, Austria	continuous loaders	
Boart Canada Inc.	Boart, South Africa and Ireland	drills	
	Boart, Mississauga	bits and steel	Longyear, Morrisette
Gardner Denver	Gardner Denver, US	drills	

Figure 7. Production of Mining Equipment in Canada



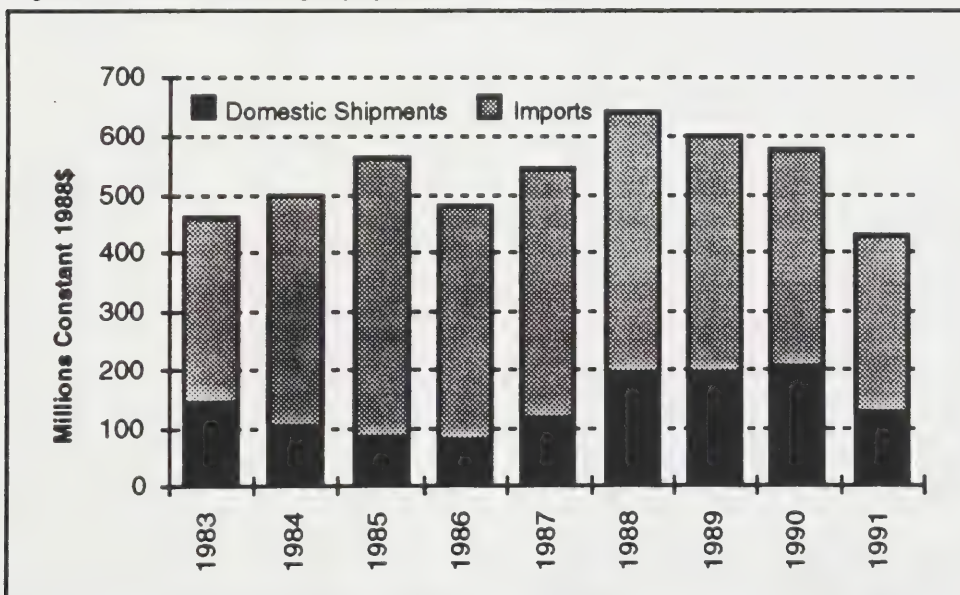
Source: Mining Equipment Sourcing Study, Industry, Science and Technology Canada 1993

4.5.1. Shipments

Between 1983 and 1991, domestic shipments and exports from Canadian establishments varied for the most part between \$300 million and \$400 million in 1988 dollars. Over this period, exports have fluctuated from a peak of \$370 million in 1983 and levels of \$180 million in 1991. Over this period between 35 and 60 percent of exports went to the US, and in 1991 the US market represented about 45 percent. Latin America accounted for between 30 and 40 percent, the European Community about 5 to 10 percent and Asia 2 to 27 percent.

Boring and shaft-sinking equipment (45-60%), ore processing equipment (17-25%), open pit draglines (5% to 12%), rock drills and bits (5-12%), and coal and rock cutters (5-13%) were the major exported products.

Figure 8. Sales of Mining Equipment in Canada



Source: Mining Equipment Sourcing Study, Industry, Science and Technology Canada 1993

Domestic shipments between 1983 and 1991 have fluctuated between \$77 million in 1986 and \$200 million in 1990, dropping dramatically in 1991 to \$120 million (Figure 8).

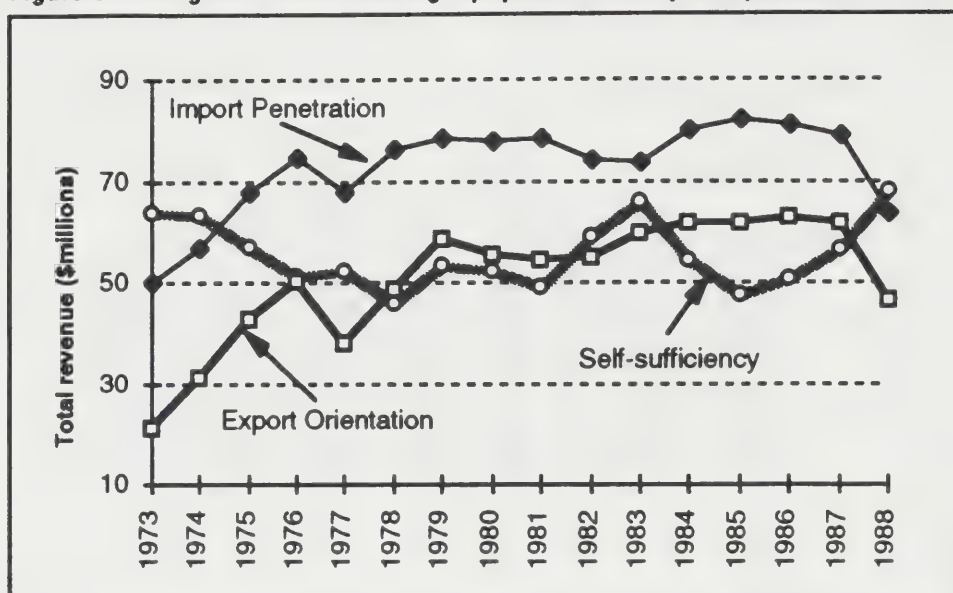
Total sales of mining equipment in Canada (both domestic shipments and imports) have varied between \$640 million in 1988 and \$430 million in 1991. The bulk of imports came from the US (70 percent), the EC accounts for 15 percent. Imports from Asia were very low.

Major imported items are rock drills and bits (35-50%), boring and sinking equipment

(19-31%), ore processing equipment (14-27%) and open pit draglines (5-11%). All mining equipment imports compete with equipment manufactured in Canada.

Two trends which are most notable for the mining equipment industry relate to export orientation and import penetration as shown in Figure 9. Over a fifteen year period, export orientation has increased from 20 to over 60 percent, while import penetration has increased from 50 percent to over 80 percent.

Figure 9. Mining and Ore Processing Equipment Industry Components



Source: Mining Equipment Sourcing Study, Industry, Science and Technology Canada 1993

4.5.2. Strategic Factors in the Mining Equipment Industry

In the early 1970s, changes in technology and mining methods occurred, such as the expansion of trackless mining, and a more intense focus on hydraulics. European companies had a more advanced development base in this area. Other factors leading to the rise in import penetration include the retrenchment of Canadian mining equipment manufacturers and increased foreign ownership and centralization of manufacturing to offshore bases. Canadian mining equipment manufacturing and value-added activities have been eroding over the past five years with a number of plant closures in response to competitive pressures, increased globalization and excess capacity world wide.

Total shipments from Canadian firms are very much dependent on total sales in the Canadian market. In response to lost sales during domestic downturn, suppliers must increasingly look towards export opportunities in order to survive.

A recent survey of Canadian mining operators and equipment manufacturers has indicated that perceived strengths in the sector are in the areas of boring machines, hoisting equipment, crushers, scissor lifts and drill bits and steel. Key factors in the areas of strength are:

- Ability to quickly customize for a specific site or operation at the time of capital spending for mine development

- Ability to modify pieces of equipment to create higher value-added functionality
- Price

These attributes give a focus on strategic opportunities in the areas of:

- Mining method
 - dealing with likely major technological changes and development requirements with significant spin-off potential and patentable applications, characterized by:
 - automated mining
 - major changes in approach to mining
 - continuous mining methods applied to hard rock ground conditions
 - specialized narrow vein mining equipment
- Mining support, representing automation options applicable to existing overall operations (i.e. not site specific) operations and methods, in areas such as:
 - real time systems/expert systems
 - energy management and ventilation
 - communications
 - optimizing and integration
 - process automation and integrated processing
- Site-specific automation, such as:
 - incremental automation/customization
 - equipment monitoring/failure identification
 - reliability/performance enhancement
 - ergonomics/safety

An example of successful collaboration is Automated Mining Systems, a joint venture company formed by Inco and Ainsworth Electric. They have developed a new technology which provides two-way voice, data and video communications capability between the surface and underground working areas, and between multiple underground locations. The technology also provides the capability for remote surveillance, monitoring, diagnosis and control of stationary and mobile underground mining and processing equipment. This technology can increase productivity, lower costs and improve safety.

It has been noted in direct interviews with mining equipment manufacturers through SCAN North value-added consultations, direct consultant interviews with the industry and during mining equipment public consultations hosted by MNDM, that to achieve success in any of the areas noted above a better organized mining equipment and services “cluster” is essential. It has been stressed that far more joint

efforts in the areas of marketing, research activities, product development and government support for the above are required. In addition, close partnering arrangements by suppliers and operators are needed to provide clear understanding of operator needs and to prove developments.

4.6. Mining-Related Services

Services companies generally supply specialized technical expertise used by mining companies primarily during the exploration, development and closure stages of the mining sequence. Examples of services would include diamond drilling, geophysical/geological/geochemical surveying, mine and processing plant engineering, environmental control engineering to name just a few.

Some of these services companies have established world-class reputations for developing advanced technologies such as airborne and ground-based geophysical techniques designed specifically for exploration for mineral deposits, environmental, geo-engineering and groundwater studies, and remote sensing, GIS and geomatics applications. The strengths of these companies lie in their collective experience in instrument design and manufacture, software design and project management.

Until the late 1980s, these services companies were sustained by commercial contracts with the domestic mining industry. Recently, however, these services companies are seeking opportunities outside Canada, many for the first time. Many are struggling to establish or improve their international capabilities and competitiveness, but some lack the financial resources and market intelligence information networks to make the transition successfully.

New areas of applied research currently being investigated by some of these companies include mineral-discriminating techniques and more sophisticated detection technologies to probe further into the earth to discover deeply-buried mineral deposits.

Recommendations pertaining to enhancing the performance of mining equipment and mining-related services sub-sectors are listed in section 5.3.

"Some mining-related service companies have established world class reputations for developing advanced technologies."

"R&D in the mineral sector has important implications to all stages of the mining sequence."

5. R&D and Marketing Considerations

5.1. Key facts with regard to mineral sector R&D

■ Decreased level of R&D in the Ontario metal mining sector during the 1980s

Ontario and Canadian expenditures in mining-related R&D have not kept pace with other sectors such as manufacturing and service sectors. For example, between 1977 and 1988, Ontario expenditures ranged from a high of \$27.2 million in 1981, to a low of \$9.5 million in 1988.

■ R&D expenditures are concentrated in a very few large firms

An analysis of Ontario mining firms who received patents in 1980 and 1986 showed that Inco accounted for over 70 percent of all patents granted in 1980 and over 50 percent of those granted in 1986. Of the 64 patents granted in those years, 57 were accounted for by Inco and Noranda.

■ Most R&D expenditures are generated by the private sector

In a review of total annual sources of R&D funding in mining from 1963 to 1990, it was determined that the largest single source of funding (70%) was from business enterprise, with a sharp growth in funding from foreign businesses (from 4% to 18.5%). Within the mining sector, almost all R&D funding comes from Canadian mining companies, with the provincial government accounting for only 1.2 percent.

In general, the less site specific a method, a process, or a piece of equipment is, the higher is the potential pay-off of long-run fundamental research. To the extent that more site specific factors dominate, short-run or incremental R&D will prevail.

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R&D in the mineral sector has important implications to all stages of the mining sequence, and includes strategies relating to the investment of funds, investment vehicles, marketing research, and the searching out of new niches for yet to be developed final products, from exploration through to mine closure and rehabilitation.

Less inventive activity, as reflected in the number of patents granted, has taken place in the Ontario mining sector over the last decade than occurred in earlier periods. One explanation for this is that it was perceived to be more profitable for Ontario mining companies to apply funds to develop new productive capacity with existing technology vs improving technology in existing plants.

Specific opportunities and policy options for promoting greater levels of private sector R&D in the mineral sector include:

- Encouraging macroeconomic policies that increase the rate of domestic economic growth and minimize economic instability - a strong economy is by far the best promoter of greater R&D expenditures.
- Encouraging universities to undertake more basic research and colleges and universities to increase the numbers of new mining engineers, scientists and technologists.
- Increasing the amount of government sponsored R&D that takes the form of contract relations with specific firms.
- Encouraging joint university-industry centres in the area of applied science or technology to accelerate the transition of fundamental scientific research to industry.
- Increasing the level of funding to firms for research purposes. This lowers the cost of innovation for firms.

Public consultation sessions on some of the options noted above were held in November, 1992. The options discussed as having most merit for the sector strategy was (1) "encouraging joint university-industry centres" and (2) "increasing the level of funding to firms for research purposes".

(1) has already been discussed in the "Exploration and Development" section. With respect to (2) above, industry and industry-sponsored R&D associations are wholly supportive of tapping the resources of the Sector Partnership Fund to expand upon the success of the Mining and Minerals Technology Program currently supported through the Canada-Ontario Northern Development Agreement. This program is regarded as being substantially underfunded and due to its northern

"Less inventive activity ... has taken place in the Ontario mining sector over the last decade than occurred in earlier periods."

Recommendations:

- Encourage technical innovation related to exploration, development, production, closure and mining equipment & services.
- Promote higher levels of applied R&D and more technology transfer opportunities in the area of mining health and safety.

Ontario focus, lacks accessibility by firms operating in southern Ontario. Many potential projects have been identified and scoped and could be implemented quickly.

5.2. Promoting Ontario Investment

Success in promoting Ontario as a good place to invest will require focusing more attention on Ontario's competitive strengths, which have been discussed in Section 4. Promoting greater investment in Ontario's mineral sector involves marketing Ontario's mineral resource strengths in metallic and non-metallic (industrial mineral) activities. For instance, already, some success has been achieved at international trade shows in Verona, Italy, where MEDT and MNDM staff are annually assisting companies to promote investment opportunities in Ontario's dimension stone industry. Ontario's dimension stone and other industrial mineral activities have great potential for further development. The production of more promotional information and more frequent attendance at international trade shows is required to achieve further results in this area.

5.3. Promoting exports of mineral products and mining-related goods and services

There is also broad opportunity to promote Ontario's high value-added activities in the area of mining related goods and services. Already, Ontario has a reputation as a leader in this area, particularly in mineral exploration and mine environmental technology. Once again, competitive analysis of sub-sectors such as mining equipment is the key to export-oriented marketing.

One of the problems in the area of promoting Ontario goods and services is a lack of sufficient membership in industry organizations such as "Ontario Mining Equipment and Services for Export" (OMESE). Low revenues inhibit the ability of trade associations to organize activities (such as planning and attending trade shows, developing "best practise" initiatives, etc.) effectively. OMESE and similar organizations like it have expressed a need for assistance to restructure, to help build up its membership in order that it can be self supporting in the future, to undertake a more concerted long-range international marketing effort.

In order to further understand industry needs in the area of marketing, a workshop was held by MNDM and attended by industry representatives. It was noted at the workshop that collectively, the mining-related goods and services sub-sector lacks organization in funding

"Ontario's dimension stone and other industrial mineral activities have great potential for further development."

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international projects, requires more credibility in foreign countries, and needs much more information on potential markets for their products.

Provincial options and opportunities in this area include:

- Providing seed capital to organizations such as OMESE so they can be self-sufficient over the long term.
- Assist in identifying/brokering specific projects which could be conducted through a consortia of business interests.
- Assist in establishing better world-wide buyer-seller linkages.
- Assist international trade commissioners to recognize mining-related goods and services opportunities for Ontario and Canada.

5.4. Investment Attraction

The mineral exploration sector would benefit from a co-operative effort by Ontario industry associations to catalogue Ontario mineral investment opportunities for national and international investors. Cataloguing would assist Ontario companies and prospectors in attracting investment dollars to finance further exploration and development work on specific Ontario mining properties. Publications on mineral investment opportunities have been produced by other mining jurisdictions.

Catalogues promoting Ontario as a good place to invest would be distributed widely at both domestic and international mining exhibits and conventions.

Recommendation:

- Promote aggressive marketing of Ontario's mining-related products and services world-wide.

"Though confronted with an on-going cost competitiveness challenge, the mineral sector, already being high-skilled and high-tech, is well positioned to move into the New Economy"

6. Conclusions and Recommendations

As noted in Ontario's new Industrial Policy Framework, achieving higher value-added in Ontario's mineral sector requires us to manage change. For the Ontario economy at large, managing change requires us to acknowledge four key forces of change that are significantly affecting the Ontario economy:

- The greening of the economy
- Changes in international trade environment
- Organizational innovation
- Adjustment in response to structural change

This report has talked to all of these forces, as they impact on the mineral sector, both in terms of the challenges they pose and in the opportunities they hold. All in all, though confronted with an on-going cost-competitiveness challenge, the mineral sector, already being a high skilled, high-tech sector is generally well-positioned to move into the New Economy in the years ahead.

6.1. Strengthening On-going Consultation

This document has examined the broad general character of the mining sector. The sector is relatively mature with well established industry associations and developed linkages between the industry and government. These linkages have been used extensively in the process of creating this document, however, further consultation with a broader range of sector representatives is important for building a broad consensus in the mineral sector and to establish the priorities for action.

In order to strengthen consultation and consensus building linkages, the Province will convene a committee of sectoral representatives. The

main task of this committee will be to review the report, prioritize all recommendations and proposed initiatives listed below, and suggest other courses of action which may allow the sector to advance in the area of higher value-added.

6.2. Summary of Recommendations

This report's recommendations, which are summarized below, suggests ways in which competitiveness can be further heightened by focusing on value-adding activities that can assist the mineral sector, and the Ontario economy, to raise skill levels, increase technological capability, establish home-based activities in Ontario, develop linkages and networks, and build international capabilities, all essential ingredients of a revitalized mineral sector and provincial economy.

1. Promote increased consultation between industry, labour, government, communities and other sector stakeholders in order to strengthen existing partnerships in the sector and to determine specific value-added R&D priorities for Ontario. More strategic linkages should be made between the mineral sector and those sectors which are present and future end-users of metals and mineral products.
2. Encourage technical innovation related to exploration, development, production, closure and mining equipment & services.
3. Foster a better public perception of mining among Ontario residents through increasing the general level of knowledge about mining, particularly its high technology characteristics, its vastly improved environmental performance and its vital economic importance to Ontario's economy.
4. Ensure excellence in professional and technical training, both institutional and company-specific, to meet the changing needs of the present and future workforce.
5. Provide access to better mining-related training opportunities by Aboriginal people and women.
6. Develop improved labour and community adjustment mechanisms.
7. Encourage excellence in applied research and improve business development opportunities in mining lands rehabilitation and other environmental matters by encouraging greater international networking and capacity-building.
8. Promote higher levels of applied R&D and more technology trans-

fer opportunities in the area of mining health and safety.

9. Assist in replenishing Ontario's known mineral reserves, by promoting dialogue on mining sector issues and advancing land-use policies which recognize the importance of mineral development to the Ontario economy.
10. Promote aggressive marketing of Ontario's mining-related products and services world-wide.

Appendix 1

World Demand Outlook for Ontario Minerals

Nickel

The capital goods sector, (commercial and industrial buildings, industrial machinery and equipment) accounts for about two-thirds of nickel use. This is followed by the consumer goods sector (refrigerators, plates, cutlery, sinks, etc.) which consumes one quarter, and the automotive sector, with a ten percent share of end-use.

Industrialized countries represent 65 percent of refined nickel consumption while about one quarter is consumed in centrally-planned economies and the former Soviet Union and East Bloc, and ten percent in developing countries. Despite their relatively small share of nickel consumption, developing countries have achieved a six percent annual rate of growth in nickel consumption between 1970 and 1991, while industrialized countries recorded 0.9 percent growth in the same period.

There has been a general decline in nickel intensity-of-use (nickel consumed per unit of GDP) in the US, Canada and other OECD countries. This

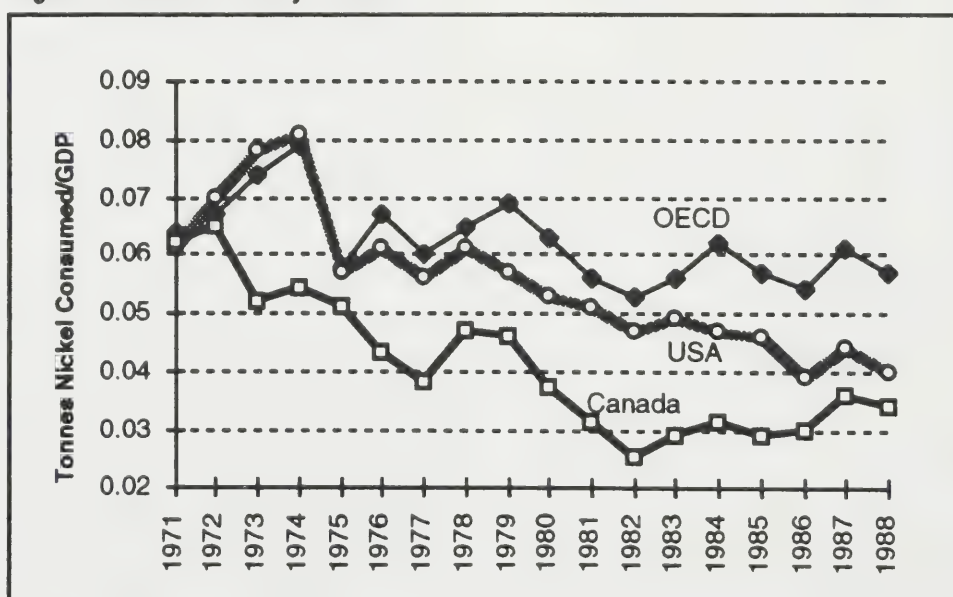
Table A. World Nickel End-Uses

	1971 (1) % of Total	1981 (1) % of Total	1986 (2) % of Total
Stainless steel	41	52	50
Alloy steel	10	9	11
Cast iron	9	9	8
Nickel alloys	15	15	16
Plating	16	10	12
Others (chemicals/magnets)	9	5	3
	100	100	100

Sources: (1) *Economics of Nickel* (4th edition), Roskill, 1984.

(2) *The Markets for Nickel*, Nickel Development Institute, 1986.

Figure A. Nickel Intensity of Use



Source: MNDM March 1991

Table B. Refined Nickel Exports

Destinations	1971 (\$000s)	1980 (\$000s)	1985 (\$000s)	1987 (\$000s)
U.S.A.	207,675	387,402	279,473	314,120
U.K.	71,181	N.A.	25,665	13,291
Japan	5,477	N.A.	34,234	55,821
Other E.E.C.	N.A.	149,654	84,741	115,071
Others	26,142	122,206	71,731	51,082
Total	310,475	659,262	495,844	549,385

Note: 1) N.A. - Not Available

2) Statistics Canada ceased reporting refined nickel exports beginning in 1988.

Source: Exports, Merchandise Trade (Annual), Statistics Canada, Cat. No. 65-202

Table C. Nickel Demand Forecasts

Published Forecasts	USA	Western World	USSR	China	World
Compound Annual Rate of Change (%)					
USBM (1983-2000)	2.5	3.1	-	-	3.1
Energy, Mines & Resources (1987-2000)	-	1.7	-	-	-
World Bank (1987-2000)	1.1	-	1.1	2.9	1.1
East-West Centre (1989-2010)	-	-	0.9	1.7	2.8
Actual (1980-1988)	0.1	3.1	0	5.4	2.7
Cooper & Lybrand Estimate (1990-2000)	-	1.6-2.0	-	-	2.5-3.5

Sources: Mineral Facts and Problems, USBM 1985; World Bank 1988;

Canadian Minerals Yearbook, EMR Canada, 1988; East-West Centre, 1990

declining nickel consumption trend may be attributed partly to substitution, in periods of high prices, by materials such as plastics, aluminum, and ceramics, and partly to the increasing role of secondary supply.

Major destinations of refined Canadian nickel continue to be US and European markets. Japan is a relatively small importer of Canadian refined nickel.

World nickel demand forecasts to the year 2000 range from 1.1 percent to 3.1 percent annual growth.

Copper

Copper's main end-use sectors users include building wire (16.2 %), plumbing and heating (15.7%), telecommunications (7.8%), electric power utilities (7.0%), in-plant equipment (7.0%), air conditioning (6.9%), and automotive (4.0%).

The most notable end-uses of copper in the US, Japan and Germany - the three largest consumers - are electrical wire and cable representing about two-thirds of total copper demand.

Japan's consistent expansion into the electronics and computer markets led to a relatively high per annum growth rate (4%) in copper consumption by its electrical sector, compared to two percent in Germany and the US.

Industrialized nations currently account for 60 percent of annual refined copper consumption, while 20 percent is consumed by developing countries. Between 1970 and 1987, the World Bank reported a less than one percent annual growth rate in copper consumption by

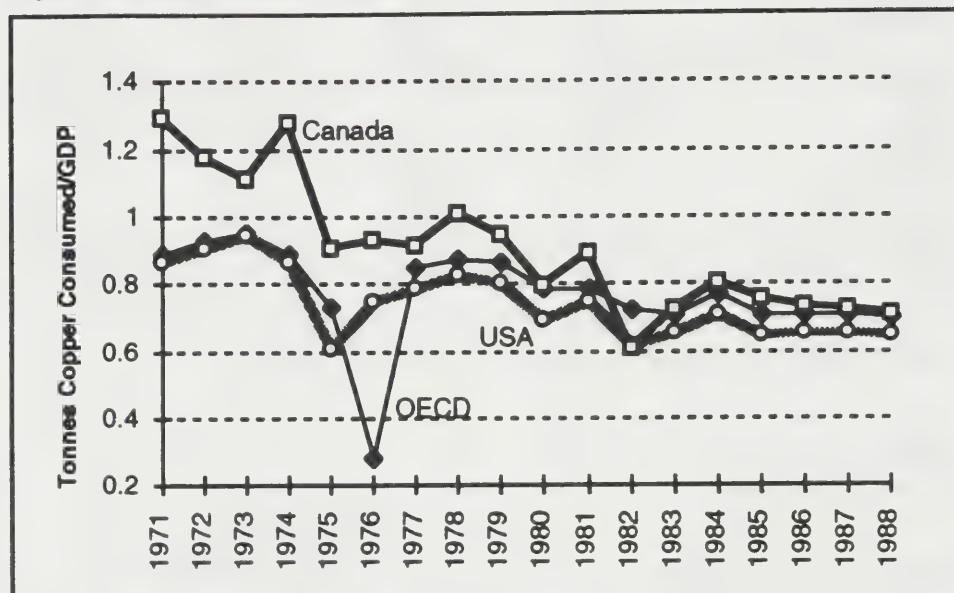
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industrial countries. The main causes of this are the substitution of aluminum and plastic and the growing importance of fibre optics in the telecommunications cables market. As in the case of nickel, copper intensity-of-use has declined over the past 20 years in Canada, the US and OECD countries, but has stabilized since the mid-1980s. In addition, the recovery of copper scrap has increased significantly, and in 1991, amounted to 45 percent of mine production.

Developing countries such as Brazil, Taiwan, South Korea, and India are rapidly increasing their investment in power distribution and telecommunications networks. Their development of light industries as well as their entry into early stages of auto production have significantly boosted their share of world copper consumption.

Published forecasts of world copper demand indicate an annual growth rate of between 1.5 and 2.0 percent for the Western world and 1.6 to 2.6 percent for the world, based on the substitution trends towards plastics in the construction sector and optical fibres in telecommunications.

Figure B. Copper Intensity-of-Use



Source: MNDM March 1992

Table D. Canadian Refined Copper Exports

Destinations	1971 (tonnes)	1980 (tonnes)	1985 (tonnes)	1988 (tonnes)
U.S.A.	107,317	126,695	135,488	186,236
U.K.	99,386	74,558	42,044	34,458
West Germany	30,574	29,495	18,151	10,418
China	-	-	24,063	-
Others	46,094	104,274	60,287	32,932
Total	283,371	335,022	280,033	264,044

Source: Exports, Merchandise Trade (Annual), Statistics Canada, Cat. No. 65-202

Table E. Copper Demand Forecasts

Published Forecasts	USA	Western World	USSR	China	World
Compound Annual Rate of Change (%)					
U.S.B.M. (1983-2000)	1.70	2.90	-	-	2.60
World Bank (1987-2000)	1.00	-	1.70	3.50	1.60
East-West Centre (1989-2010)	-	-	0.50	3.30	2.10
Actual (1980-1988)	2.10	1.90	(50)	2.90	1.60
Coopers & Lybrand Estimate (1990-2000)	-	1.5-2.0	-	-	2.0-2.5

Source: Mineral Facts and Problems, USBM 1985; World Bank, 1988; Eighteenth Centre for Resource Studies Policy discussion Seminar, 1987; East-West Centre, 1990.

Table F. Canadian Slab Zinc Exports

Destinations	1971 (tonnes)	1980 (tonnes)	1985 (tonnes)	1988 (tonnes)
U.S.A.	144,055	278,226	371,156	418,830
U.K.	59,296	50,479	41,089	25,879
China	-	-	44,059	9,369
Taiwan	-	4,364	10,777	21,761
Others	80,989	138,880	88,540	80,980
Total	284,340	471,949	555,621	556,819

Source: *Exports, Merchandise Trade (Annual)*, Statistics Canada, Cat. No. 65-202

Table G. Zinc Demand Forecasts

Published Forecasts	USA	Western World	USSR	China	World
Compound Annual Rate of Change (%)					
USBM (1983-2000)	1.8	1.9	-	-	1.9
Energy, Mines & Resources (1987-2000)	-	1.3	-	-	-
World Bank (1987-2000)	0.5	-	1.3	-	1.5
East-West Centre (1989-2010)	-	-	1.5	3	2.1
Actual (1980-1988)	2.7	2	0.6	8.5	1.8
Coopers & Lybrand Estimate (1990-2000)	-	1.7-2.0	-	-	1.8-2.2

Source: *Mineral Facts and Problems*, USBM 1985; *World Bank*, 1988; *Eighteenth Centre for Resource Studies Policy discussion Seminar*, 1987; *East-West Centre*, 1990.

Table H. Canadian Gold Exports

Destinations	1976* (kg)	1980 (kg)	1985 (kg)	1988 (kg)
U.S.A.	46,080	54,084	99,260	45,416
Japan	-	113	5,313	31,550
Hong Kong	-	305	1,037	23,827
Others	11,360	6,134	2,903	22,212
Total	57,440	60,636	108,513	123,005

* First year of reporting.

Source: *Exports, Merchandise Trade (Annual)*, Statistics Canada, Cat. No. 65-202

Zinc

Germany, the US and Japan are currently the three top zinc-consuming countries. Zinc is becoming increasingly important in galvanized products (particularly for use in auto production) in the both the US and Japan. In addition, brass manufacturers in Japan and Germany have raised zinc consumption. However, reduced use of zinc in die-casting in the auto industry has contributed to significant declines in total zinc used. Material substitution, weight conservation and thinner sheet metal in US automobiles have also contributed to a heavy fall in demand.

Overall, the forecasts expect refined/slab zinc demand to grow at an annual rate of 1.7 to 2.0 percent for the Western World and 1.5 to 2.2 percent for the World.

Gold

In 1991, gold's main end-use sectors included carat jewellery (75%), bar-hoarding (9%) and electronics (5%). At the end of the last decade, rising real incomes, the absence of gold price volatility and the downward adjustment of the US currency value contributed to a higher demand for carat jewellery and bar-hoarding as investment vehicles.

Developing countries' demand for gold for carat jewellery and for a growing electronics sector resulted in an 18 percent annual rate of

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growth in gold consumption since 1980, compared to a four percent annual increase noted in industrialized countries over the same time period.

Uranium

Uranium is used as a nuclear fuel for electric power generation. In this end-use, it has no substitutes. Minor amounts of depleted uranium are used in the aerospace industry as ballast, because of its high density, and in radiation shielding and containers for radioactive materials.

Ontario Hydro is by far the largest uranium-consuming utility in Canada, and will continue in this position for the foreseeable future. Although Ontario Hydro purchases most of its uranium requirements under contract from Saskatchewan, some is bought under contract from Rio Algom, Ontario's only remaining uranium producer. The utility has announced that this contract will not be extended beyond 1996, and at that time uranium mining operations will cease in Ontario.

Salt

Salt is an industrial mineral which serves the regional domestic market. Less than 20 percent is exported to the United States. The industrial chemicals industry is the primary user of salt in Northern America, accounting for half of both Canadian and US salt demand annually. De-icing is the second major end-use market for salt, and the total Canadian consumption of salt for this purpose is 45 percent. Other end-uses for salt include food and meat packaging and pulp and paper.

Since the cost of transportation for a low unit-value commodity such as salt is an overriding concern, the US market serves as the only export outlet of significance for Canadian salt. While the Canadian chemicals sector has increased its salt demand two and a half times since 1971, the US chemical industry's salt consumption has declined over the same time period.

Table I. Canadian Salt Exports

Destinations	1971	1980	1985	1988
% of Canadian Total				
U.S.A.	98.7	92.7	97.6	98.9
U.K.	1.3	7.3	2.4	1.1
Total	100	100	100	100

Source: Exports, Merchandise Trade (Annual), Statistics Canada, Cat. No. 65-202

Table J. US Salt Demand Forecast

1983	2000 (Forecast Range)		Probable	Probable Average Annual Growth Rate
	Low	High		
	(000s t)	(000s t)	(000s t)	1983-2000 (%)
36,450	43,680	63,700	52,780	2.2

Source: USBM 1985

Growth in salt demand is expected to be minimal, as growth in demand in the US chemical products is expected to be offset by declines in salt use in the food, pulp and paper and textile industries as a result of heightened health and environmental concerns.

Table K. Canadian Gypsum Exports

Destinations	1971	1980	1985	1988
% of Canadian Total				
U.S.A.	98.5	100	99.4	99.4
U.K.	1.5	0	0.6	0.6
Total	100	100	100	100

Source: *Canadian Minerals Yearbook*

Table L. U.S. Gypsum Demand Forecast

1983	2000 (Forecast Range)		Probable	Probable Average Annual Growth Rate
	Low (000s t)	High (000s t)	(000s t)	1983-2000 (%)
19,877	26,390	33,670	30,940	2.6

Source: *USBM 1985*

Gypsum

Generally, many producers of wallboard and cement mine their own gypsum and therefore, internal consumption is not reported. Two thirds of crude Canadian gypsum is exported annually to the US from Nova Scotia, however all Ontario gypsum is made into wallboard prior to export, adding value to the provincial economy. Like salt, gypsum is a bulky, low-value commodity with high transportation costs. The regional US market is, in all

respects, the sole outlet for Canadian gypsum.

Major end-uses for gypsum included wallboard (66%), portland cement (19%), and agriculture (4%). Both wallboard and cement are used entirely in residential, commercial and industrial construction. Therefore, gypsum demand is directly related to the performance of the North American construction industry.

US gypsum demand is expected to increase at a 2.6 annual rate, and is dependent upon the growth of the US construction sector.

Summary

Toward the year 2000, the Western world will remain the largest consumer of Ontario minerals, although downward trends in intensity-of-use have been noted in nickel, copper and zinc. Growth in demand for metals will be strongest in developing countries. Overall demand for nickel, copper and zinc is expected to remain firm.

Due to the strong relationship between demand for metallic and non-metallic minerals and performance in downstream industries (construction, chemicals, auto production, etc.), changes in current mineral demand will remain highly dependent on how quickly end-user sectors move out of recession.

Appendix 2

Ontario Mineral Supply Outlook

Nickel

Ontario's nickel reserves have declined over the past decade, and total nickel reserves are only adequate for another than 30 years of production at current levels of output.

Copper

Ontario copper reserves have declined at a slightly faster rate than nickel reserves, and are adequate for only 20 years at current levels. Over 70 percent of provincial reserves are accounted for by the nickel-copper ore bodies in the Sudbury district, with a further 25 percent accounted for by the Kidd Creek zinc-copper ore body, in the Timmins area. Reserve depletion and resulting job loss is a major threat to Timmins.

Zinc

The reserve position for zinc is even less favourable and is only adequate for about 10 years of output at current production levels. Over 60 percent of the province's zinc is contained in the Timmins Kidd Creek ore body. A major exploration effort will be required if new reserves are to be brought into production, within a time span of around eight years.

Gold

Gold reserves have increased rapidly, as Ontario gold reserves have tripled between 1981 and 1988. The three Hemlo gold mines near Marathon account for approximately 55 percent of current Ontario gold reserves. The Campbell Mine (Red Lake) accounts for an additional 15 percent of current reserves. The remaining reserves are distributed among smaller operations and by-product sources. The mine life of smaller operations tends to be estimated at ten years or less but the potential for discovery of additional resources close to existing mines is considered high.

Salt

The salt resource of the province is abundant and not considered to be a constraint to future production. The competitive position of Ontario's salt producers is fundamentally sound, and it is anticipated that any downward pressure on production levels would come from the demand side, such as slower than anticipated growth in industrial chemicals production.

Gypsum

The competitive position of the Ontario gypsum and gypsum wall-board producers appears good, with some mines reporting reserves of 75 years. Any constraint to production would be derived from annual fluctuations in North American construction activity. Over the long-term, it is possible that gypsum resources in the Moose River basin in northern Ontario may be developed. The relatively remote location suggests that comparatively high value-added gypsum products, such as those for the pharmaceutical and speciality sectors, would need to be produced close to the mine in order to justify the additional crude gypsum production.



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